CIVIL ENGINEERING

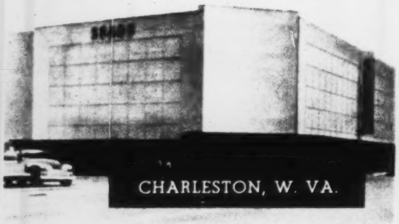
AMERICAN SOCIETY OF CIVIL ENGINEERS FOUNDED 1852
PENNEY'S

ALASKAN WAY VIADUCT
SEATTLE, WASHINGTON
see article by Ralph W. Finke

RAYMOND SERVES SEARS ROEBUCK

INGLEWOOD, CAL.

Architect: Stiles O. Clements.
Contractor: L. E. Dixon Co.

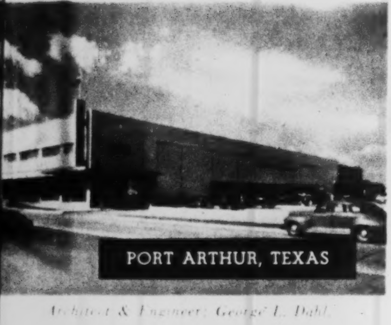

CHARLESTON, W. VA.

Architect: The Ballinger Co.
Contractor: Wise Contracting Co., Inc.

COMPTON, CAL.

Architect: Stiles O. Clements.
Contractor: L. E. Dixon Co.

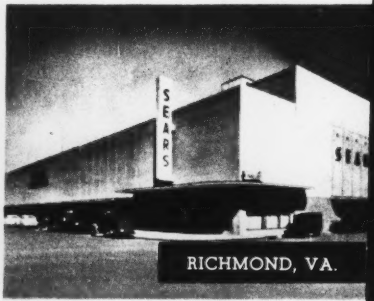
Sears Roebuck & Company continues to turn to Raymond for their foundation work . . . Sixteen different Sears stores (seven shown here) in ten States rest on Raymond piles . . . These repeat performances are further evidence that leading industrial organizations consistently utilize Raymond services for their important projects.


PORT ARTHUR, TEXAS

Architect & Engineer: George L. Dahl.

NORFOLK, VA.

Architects: Shutze & Armistead. Engineer: Robert G. Lose. Contractor: A. Artley Co.


RICHMOND, VA.

Architect: The Ballinger Co.
Contractor: Wise Contracting Co., Inc.

ASHVILLE, N. C.

Architects: Shutze & Armistead.
Contractor: Merchant Construction Co.

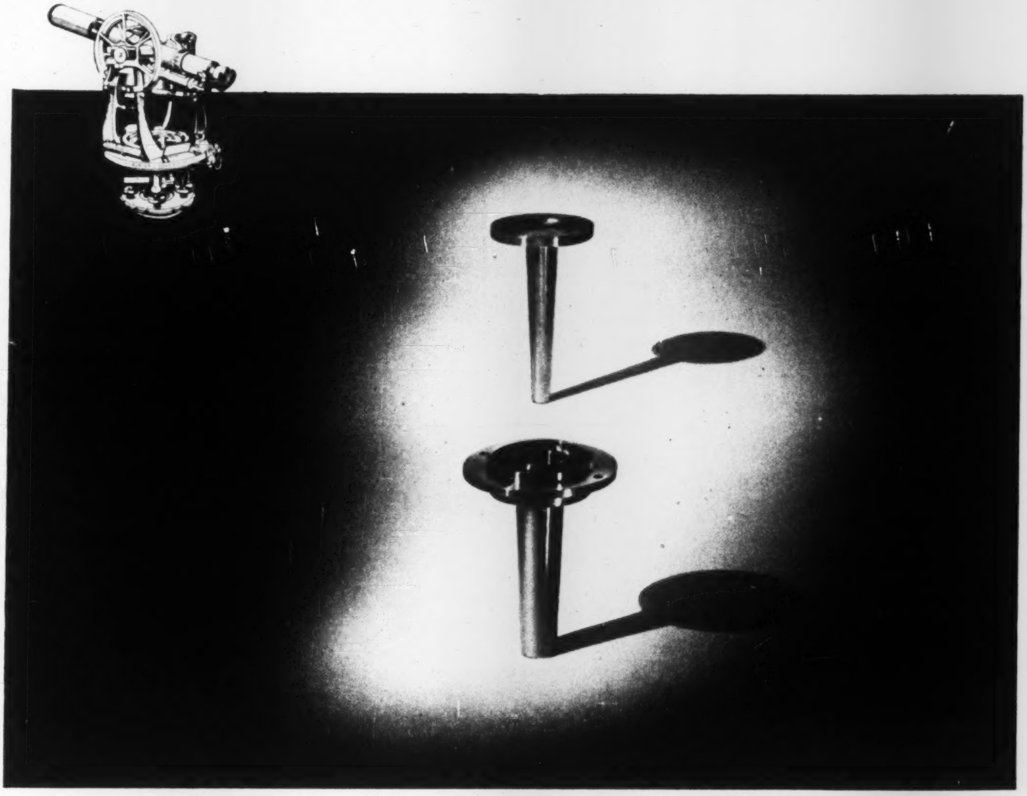
RAYMOND CONCRETE PILE CO.

140 CEDAR STREET · NEW YORK 6, N.Y.

Branch Offices in the Principal Cities of United States and Central and South America

AROUND THE WORLD
FOUNDED 1897

SCOPE OF RAYMOND'S ACTIVITIES . . . Foundation Construction . . . Harbor and Waterfront Improvements . . . Soil Investigations . . . In-Place Pipe Lining Specialized Construction.



It's the way a Berger Transit is made that makes it better

WE MAKE OUR CENTERS THE HARD WAY
FOR GREATER ACCURACY IN READING ANGLES AND LEVELING

You'd think precision machining was all it takes to produce free-rotating transit centers, without play or wear over long service periods. But that's not the way Berger craftsmen see it!

So they patiently and meticulously lap each Center by hand—after precision tool finishing—to smooth away any remaining minute rough spots within less than .0001" and produce a mirror-like over-all bearing surface. Then the matched-fit of the inner and repeating Center assembly assures that unvarying true center of rotation—the basis of accurate readings of angles and leveling.

And that's not all: Berger Transit Centers are all bronze. The inner spindle is bell metal with equal coefficient of expansion—another reason why they revolve so freely within each other without fretting or binding under any variation of climatic condition. They're larger, too, with greater bearing contact between the inner and outer working areas—as much as 5½ square inches in a 6¼-inch Berger Transit.

Here is just one more of the many *extra* long-term values you can count on when you buy BERGER—as so many leading engineers do. C. L. Berger & Sons, Inc., 37 Williams St., Boston 19, Massachusetts.

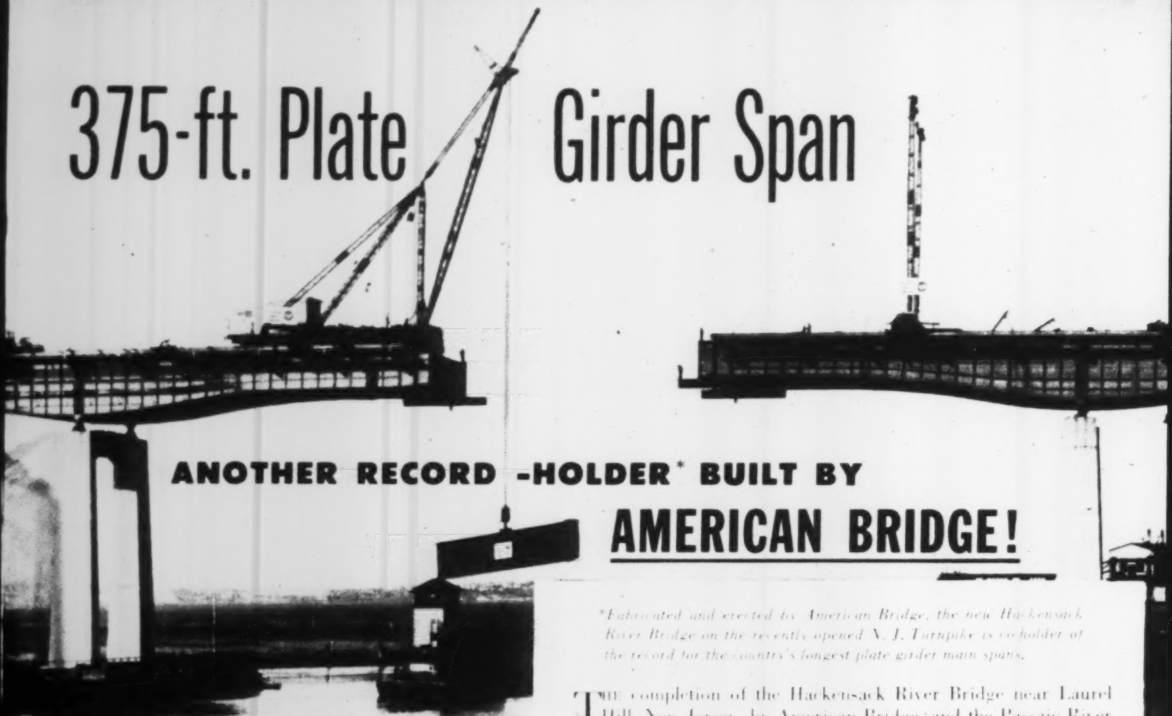
IF YOU'VE NEVER OWNED A BERGER, *you owe it to yourself to learn how accurate it really is...how little repair it requires...the lifetime of trouble-free service you can count on...how inexpensive a Berger Instrument is in the long run. Write for a copy of "Accuracy in Action."*

THE BEST IN SIGHT IS BERGER

ENGINEERING AND SURVEYING INSTRUMENTS...SINCE 1871

CIVIL ENGINEERING, The Magazine of Engineered Construction, December, 1952. Vol. 22, No. 12. Published monthly by the American Society of Civil Engineers. Publication office 20th and Northampton Streets, Easton, Pa. Editorial and advertising departments at the headquarters of the Society, 33 West 39th Street, New York, N. Y. Price 50¢ a copy, $5.00 a year in advance, $4.00 a year to members and to libraries and $2.50 a year to members of Student Chapters. Canadian postage 75¢ and foreign postage $1.50 additional. Entered as second class matter September 23, 1930, at the Post Office, Easton, Pa., under the Act of August 24, 1912, and accepted for mailing at a special rate of postage provided for in Section 1103, Act of October 3, 1917, authorized on July 5, 1918.

375-ft. Plate Girder Span



ANOTHER RECORD-HOLDER* BUILT BY

AMERICAN BRIDGE!

**Fabricated and erected by American Bridge, the new Hackensack River Bridge on the recently opened N. J. Turnpike is co-holder of the record for the country's longest plate girder main spans.*

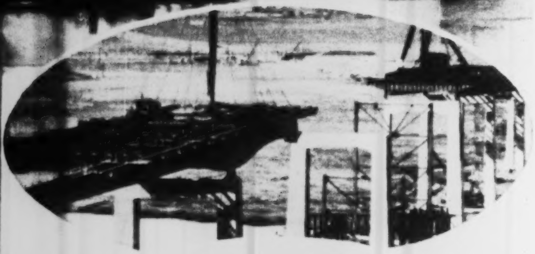
THE completion of the Hackensack River Bridge near Laurel Hill, New Jersey, by American Bridge, and the Passaic River Bridge by another contractor, permitted the opening of the final nine-mile section of the 118-mile New Jersey Turnpike. These two bridges with main spans of 375 ft. set a new U.S. record for lengths of plate girders.

The Hackensack River Bridge has a total length of 5613'3" c. to c. of end bearings on abutments and provides six 12 ft. traffic lanes, a 6 ft. center mall and two 3 ft. safety walks. The 375 ft. main span with two flanking spans of 275 ft. each, c. to c. of bearings, are composed of two continuous girders spaced 56' apart with a maximum depth of 21'6½" b. to b. of flange angles over the piers.

The south approach contains a 5000 ft. radius curve and the north approach a 4000 ft. radius curve. The spans on curves are super-elevated and both approaches are on a 3% grade with a 940 ft. length vertical curve symmetrical about the center of the river span. Silicon steel was used for all main girder material.

The New Jersey Turnpike now provides another link in the envisioned north-south expressway and extends from the Delaware Memorial Bridge below Wilmington, Delaware, to connections with the main crossings of the Hudson River to New York—the Holland and Lincoln Tunnels and the George Washington Bridge.

The over fifty years of bridge building experience, the technically trained personnel, the most modern equipment of American Bridge, were needed to build a bridge of this magnitude, again living up to its old motto, "If the engineers can design it, American Bridge can build it."



Project: Hackensack River Bridge
Owner: New Jersey Turnpike Authority
Consulting Engineers: Howard, Needles, Tammen & Bergendoff
Consulting Architects: Fellheimer and Wagner
Fabricated and Erected by American Bridge Division, United States Steel Company

AMERICAN BRIDGE DIVISION, UNITED STATES STEEL COMPANY
GENERAL OFFICES: 525 WILLIAM PENN PLACE, PITTSBURGH, PA.

Contracting Offices in: AMBRIDGE · ATLANTA · BALTIMORE · BIRMINGHAM · BOSTON · CHICAGO · CINCINNATI · CLEVELAND · DALLAS · DENVER · DETROIT · DULUTH · ELMIRA · GARY · MEMPHIS · MINNEAPOLIS · NEW YORK · PHILADELPHIA · PITTSBURGH · PORTLAND, ORE. · ROANOKE · ST. LOUIS · SAN FRANCISCO · TRENTON

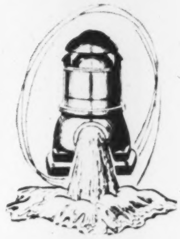
UNITED STATES STEEL EXPORT COMPANY, NEW YORK

AMERICAN BRIDGE

USS

UNITED STATES STEEL

WATER for Atlantic City's RITZ-CARLTON



DATA:

- —WELL: Drilled by rotary clay-seal process, 850 feet deep in the Kirkwood stratum; double cased and graveled.
- —CASING: 145 feet of 16" and 747 feet of 12" steel.
- —SCREEN: 61 feet of 6-guage Armco Iron.
- —PUMPS: Originally equipped with 4-stage 15" bowls with cast iron impellers. Later replaced with 5-stage 12" bowl and bronze impeller.
- —MOTOR: Original 25 HP electric still giving good service.

There are Layne Associate Companies located throughout the country. The one near you already understands the drilling and water bearing formations in your area.

ON ATLANTIC CITY'S famous board walk, stands one of America's loveliest hotels—the Ritz-Carlton. Twenty-eight years ago, the owners turned to Layne for a well and pump installation. In the intervening years—over a quarter century, they have never experienced one fraction of disappointment in the dependability, durability and ever faithful performance of their purchase.

In the twenty-eight years of almost constant operation, the Layne unit has produced more than 1,471,680,000 gallons of water—all the fresh water needed by this great hotel. Upkeep expense since the day installed has averaged less than a hundred and seventy dollars a year. One amazing fact is that the original Armco iron screen is still functioning. Another is that the well was installed by a method that completely sealed off all infiltration of salt water in a most difficult salt water area. Such is the life expectancy, satisfactory operation and generally low upkeep expense of Layne wells and pumps.

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WATER WELLS
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WATER TREATMENT

Now...

the famous MOTOR SCRAPER

joins the A-C ALLIS CHALMERS line

In order to serve you more completely, Allis-Chalmers has extended the *Finest Line on Earth* by adding the famous MOTOR SCRAPERS and MOTOR WAGONS formerly manufactured by LaPlant-Choate. This customer-accepted line meets A-C's 4-point quality requirements in every way.

These big self-propelled units are *designed for your job* . . . easy loading, high-speed hauling and quick, clean ejection. They're *built to take it* . . . job-tested, job-proved through years of use all over the world. Like Allis-Chalmers other earthmoving equipment, the MOTOR SCRAPER is *easy to operate . . . simple to service.*

Today's jobs require a more careful selection of equipment. That's why you'll be money ahead if you make your nearby industrial A-C dealer your headquarters for crawler tractors, motor graders, MOTOR SCRAPERS and MOTOR WAGONS. Stop in soon to discuss your job requirements and see his complete parts and service facilities.

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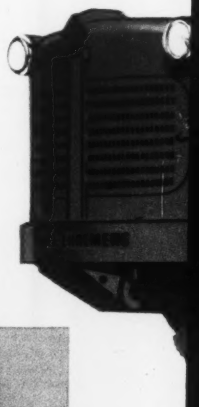

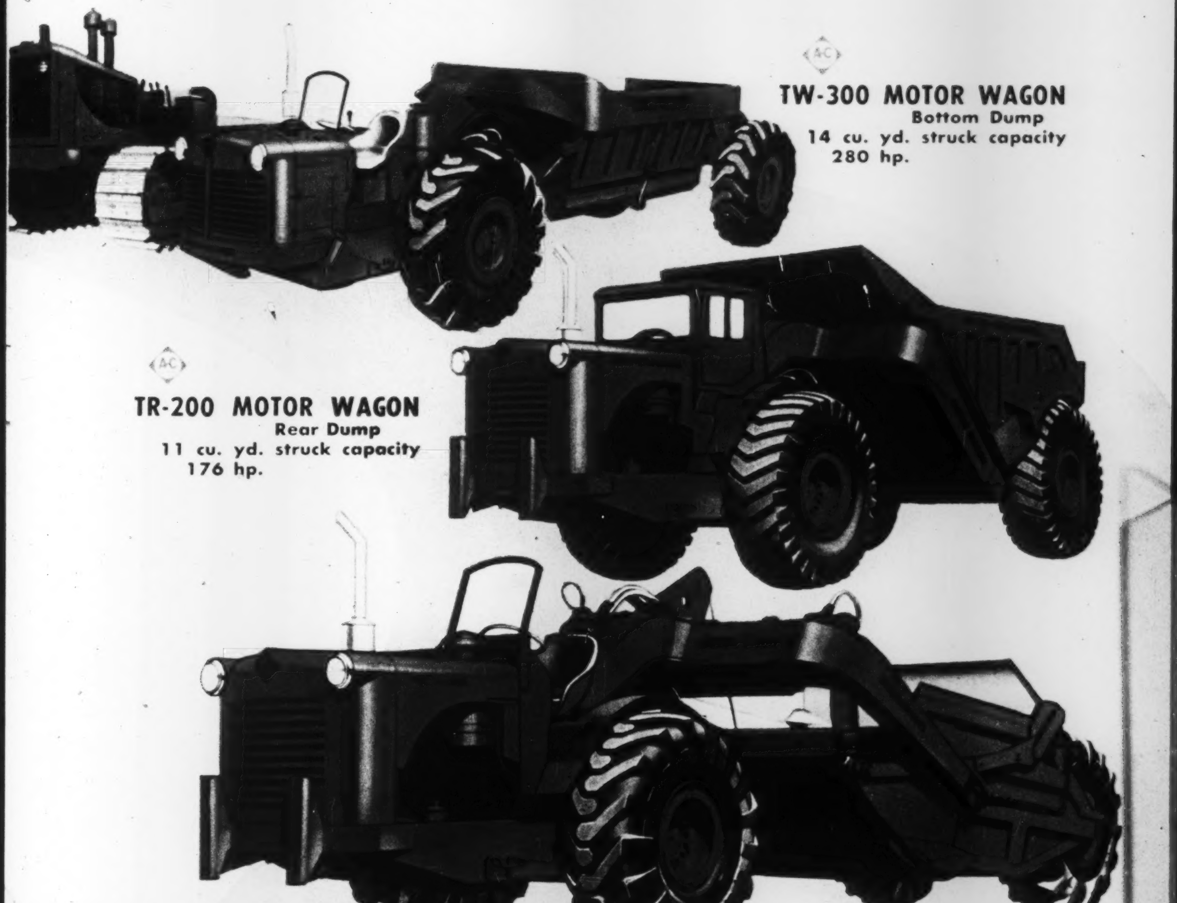

TW-300 MOTOR WAGON
Bottom Dump
14 cu. yd. struck capacity
280 hp.

TR-200 MOTOR WAGON
Rear Dump
11 cu. yd. struck capacity
176 hp.

TS-200 MOTOR SCRAPER
10 cu. yd. struck capacity
176 hp.

TS-300 MOTOR SCRAPER
14 cu. yd. struck capacity
280 hp.

the Finest Line on Earth

SAVE STEEL

...and Money, too!

on school construction

Frostburg High School
Frostburg, Md.
Architect: R. H. Hitchins
Contractor: J. J. Bendik

Whittier Union High School, Whittier, Calif. Architect: W. H. Harrison. Struct. Engineer: P. E. Jeffers. Contractor: J. K. Thomas.

...build with REINFORCED CONCRETE

Today, more and more schools are being built with reinforced concrete frames. Reinforced concrete requires from 60 to 65% less steel, permitting builders to stretch their steel allotments. Furthermore, reinforced concrete frames save money! In case after case, cost comparisons have proved the basic economy of reinforced concrete.

Reinforced concrete is faster to erect, too, and is inherently firesafe and durable—highly resistant to wind, shock, and quakes. On your next structure it will pay you to *design for reinforced concrete!*

HOW REINFORCED CONCRETE SAVES STEEL
COLUMNS Use Less Steel
BEAMS Use Less Steel
Complete BUILDINGS Use Less Steel

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The Surveyor's Notebook

Reporting on Unusual Surveying Problems and Their Solutions

Notekeeper: W. & L. E. Gurley, America's Oldest Engineering Instrument Maker

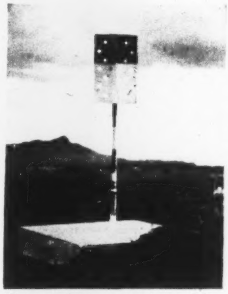
"A Bit More Mauka . . . A Few Feet Makai"

"Surveys in Hawaii introduce many new features to a surveyor trained on the mainland," says Russell Brinker, Head of the Department of Civil Engineering at Virginia Polytechnic Institute.

"The ancient land system divided an island roughly into several *mokus* (districts). Each *moku* was split into *ahupua'as*, pie-shaped pieces extending from ocean to mountain top and varying considerably in area.

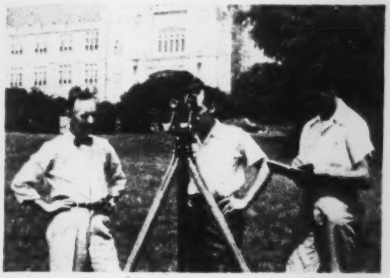
"Theoretically, each *ahupua'a* contained a *kai* (sea fishery), a stretch of *kula* (upland) and some *kuahiwi* (forest and mountain land). Thus, the ruling chief and his people could get fish, taro and wood from their own land holdings in the Islands.

"To trace old deeds, today's surveyor must be able to read descriptions in a 12-letter Hawaiian alphabet. Simple terms like North and South are frequently discarded in favor of visual directions. What, then, could be easier than to send a rodman a bit more *mauka* (mountainward) or a few feet *makai* (oceanward)? Or to tell the chainman to move Diamond Head-way or Punchbowl-way?



Triangulation stations like this are common in Hawaii.

"In the mid-'30's, I surveyed small parcels in the Islands for the Government, so that portions could be taken out of rice production. Standard practice was followed the first half day by measuring angles at corners, and lengths along dike sides of the flooded rice paddies. Since ties between adjacent ownerships and exact areas were not needed, a faster, less accurate method seemed necessary.



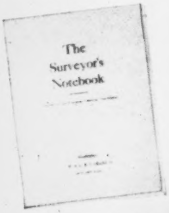
Prof. Russell Brinker (left) instructs students at VPI in the use of the transit. The instrument is one of 25 Gurley transits and levels owned by VPI.

"So we set up near the estimated center of an individual farm on a paddy bank. Two rodmen started at diagonally-opposite corners and moved clockwise around the field. Stadia distances and azimuths from an arbitrary reference line were read on the two rods in alternate order and recorded.

"As soon as all corners had been sighted, we set up in the next field and repeated the process. Readings were plotted later and areas obtained by planimeter."

Have you received your copy of the collected stories from "The Surveyor's Notebook"? The book contains all articles and field tips from the first year's series. Thousands of surveyors are finding that it is very helpful in their work.

Write for your free copy.



What's your story? We would like to feature it in a future page in this series. Drop us a line, outlining your idea. We'll contact you later for full details.

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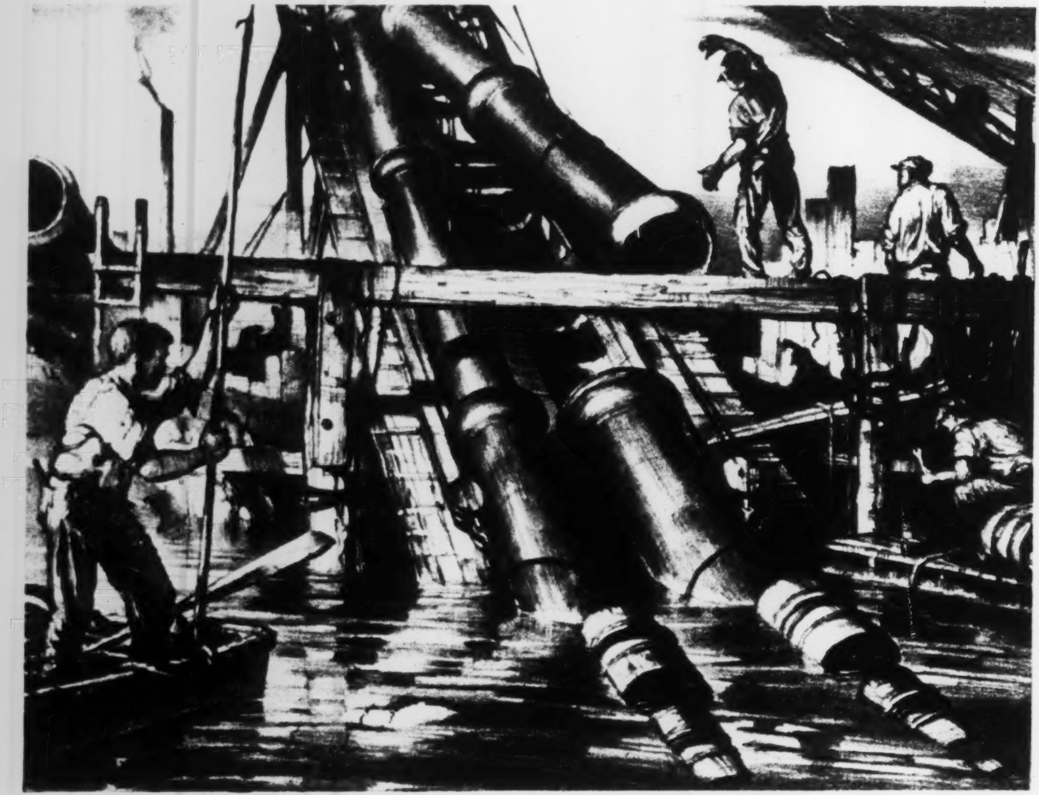


Lithographed on stone for U. S. Pipe and Foundry Co. by John A. Noble, A. N. A.

WHEN A CAST IRON water, gas or sewer line crosses a stream flexible joint pipe is frequently used. Joints that will deflect enough to meet installation and post-installation conditions and remain tight are most important in a submarine installation.

U. S. flexible joint pipe in all sizes, and pipe 30-inch and larger with other types of joints, are produced by the *pit cast* process. In sizes 2-inch through 24-inch, U. S. pipe is cast *centrifugally* in metal molds with bell-and-spigot, mechanical joint or plain ends

Rigid quality controls are employed throughout the manufacture of all types of U. S. cast iron pipe from raw materials to finished products.

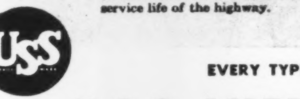
U.S. PIPE

United States Pipe and Foundry Co.,
General Offices, Burlington, N. J.
Plants and Sales Offices Throughout the U. S. A.

The Edens Expressway

Shown here is a typical section of the Edens Expressway, an important part of the highway network that serves the Chicago area. Illinois State highway engineers specified American Welded Wire Fabric reinforcement with contraction joint spaces of 100′-0″ centers to insure long, trouble-free service and a smooth riding surface from this main traffic artery—and also reduced construction costs.

IDEAL FOR USE with modern paving machinery, American Welded Wire Fabric is also generally preferred for concrete reinforcement in city streets, curbs, sidewalks and sewers—in culverts, abutments and bridges—in foundations, yards, floors, walls and roofs of all sorts of buildings.



AS THE WHEEL LOAD approaches an open crack in plain pavement, one slab end carries the entire load. As the wheel approaches the closed crack in pavement reinforced with American Welded Wire Fabric, both slab ends, instead of one, carry the load, preventing damage to the slab and to the subgrade, reducing the rate of cracking, preventing heaving and spalling, which reduces maintenance cost and increases the service life of the highway.

built stronger, to last longer and to ride smoother with

AMERICAN WELDED WIRE FABRIC

On many a mile of the Nation's highway system, American Welded Wire Fabric has helped to improve driving conditions, reduce construction costs and save important money on maintenance—and very important, it protects the public's investment through longer pavement life.

With American Welded Wire Fabric, the many small high-yield steel members keep the driving surface smooth and even, make possible longer slabs and fewer joints, hence increase riding comfort and safety.

The big flat sheets are easily placed by minimum crews, lie flat and stay put during pouring. Higher allowable stresses mean that you use less steel, less concrete. The result is—savings on materials and labor that sharply reduce construction costs.

Long experience has proved that American Welded Wire Fabric reinforcement reduces the rate of cracking, prevents progressive damage to slab and subgrade, insures additional years of trouble-free service, thus cutting maintenance costs to the bone.

Our specialists will be glad to consult with you on your individual reinforcing problems. You will find that most jobs can be handled with some of the many standard designs, styles and sizes of American Welded Wire Fabric that are now readily available. Why not drop a line to our nearest sales office for a copy of the American Welded Wire Fabric Catalog.

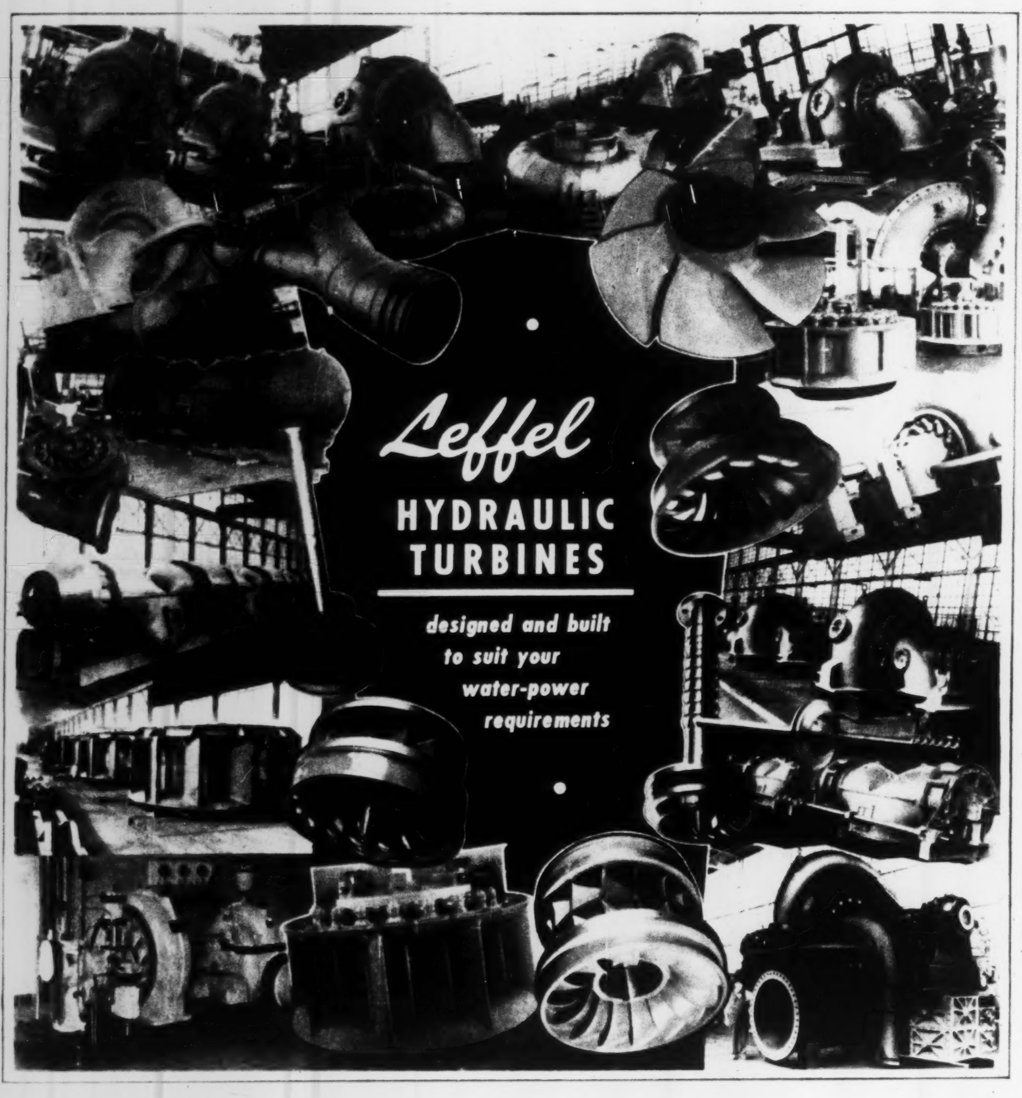
AMERICAN STEEL & WIRE DIVISION, UNITED STATES STEEL COMPANY
GENERAL OFFICES: CLEVELAND, OHIO
COLUMBIA-GENEVA STEEL DIVISION, SAN FRANCISCO, PACIFIC COAST DISTRIBUTORS
TENNESSEE COAL & IRON DIVISION, FAIRFIELD, ALA., SOUTHERN DISTRIBUTORS
UNITED STATES STEEL EXPORT COMPANY, NEW YORK

USS

EVERY TYPE OF REINFORCED CONCRETE CONSTRUCTION NEEDS

U·S·S AMERICAN WELDED WIRE FABRIC

UNITED STATES STEEL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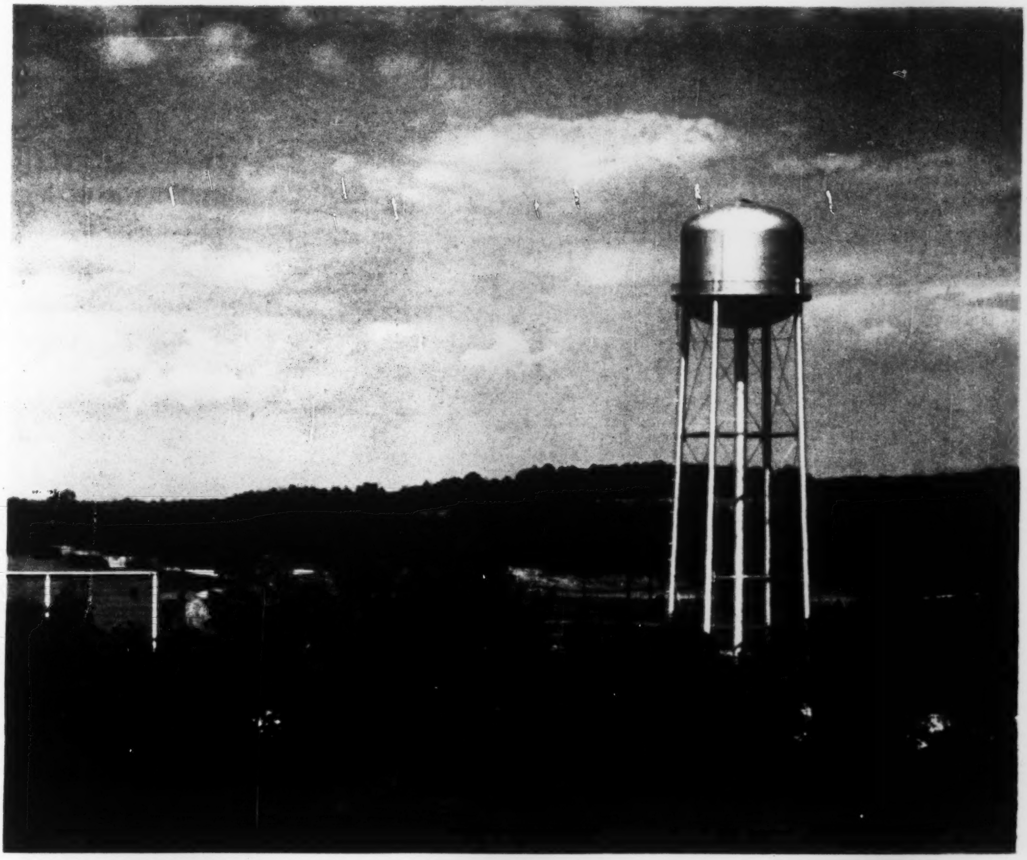
HYDRAULIC TURBINES
designed and built to suit your water-power requirements

FOUNDED IN 1862

THE JAMES LEFFEL & CO.

DEPARTMENT C • SPRINGFIELD, OHIO, U. S. A.

MORE EFFICIENT HYDRAULIC POWER FOR 90 YEARS



A Water System that Guards Against Emergencies

Textile manufacturers cannot gamble on fire protection. They must be sure! That's why a 100,000-gallon Horton elevated tank and an automatic sprinkler system were installed at the Maverick Mill's White Horse Mill at White Horse, S. C.

Water in this tank assures an independent supply that is available at all times for fire protection. The sprinkler system installed by the Daniel Construction Company provides an instantaneous, automatic means of getting water from the tank to the fire area.

If a fire should break out any hour of the day or night, heat from the fire will open the nearest sprinkler head. Water under gravity pressure from the Horton tank will spray from the opened sprinkler head quenching the fire before it has a chance to gain headway.

Horton elevated tanks for fire protection are built in standard capacities from 15,000 to 500,000 gallons with ellipsoidal-bottoms. We also build elevated tanks with radial-cone bottoms in sizes from 500,000 to 3,000,000 gallons. Horton Waterspheres are available in capacities from 25,000 to 250,000 gallons.

All Horton elevated tanks providing water under gravity pressure for automatic sprinkler systems are built in accordance with the requirements of the National Board of Fire Underwriters, the Inspection Department of the Associated Factory Mutual Fire Insurance Company or the Factory Insurance Association.

For complete information, write our nearest office. Include desired capacity, height to bottom, and location.

CHICAGO BRIDGE & IRON COMPANY

Atlanta 3	2167 Healy Bldg.	Detroit 26	1541 Lafayette Bldg.	Philadelphia 3	1652—1700 Walnut St. Bldg.
Birmingham 1	1596 N. Fiftieth St.	Havana	402 Abreu Bldg.	San Francisco 4	1584—200 Bush St.
Boston 10	1009—201 Devonshire St.	Houston 2	2128 C & I Life Bldg.	Seattle 1	1309 Henry Bldg.
Chicago 4	2199 McCormick Bldg.	Los Angeles 17	1556 General Petroleum Bldg.	Tulsa 3	1647 Hunt Bldg.
Cleveland 15	2263 Guildhall Bldg.	New York 6	3395—165 Broadway Bldg.	Washington 6, D.C.	1156 Cafritz Bldg.

Plants in BIRMINGHAM, CHICAGO, SALT LAKE CITY and GREENVILLE, PENNA.

Secondary roads in Ionia County, Michigan, are among the finest in the country. Back of these roads is the experienced and expert supervision of Allen M. Williams, right, County Road Engineer and Superintendent, shown here with Howard M. Rotrock, Standard Asphalt Engineer.

First choice for secondary roads

More and more alert road builders, in the Midwest, are utilizing the benefits offered by Standard Oil's improved Road Oils to build better secondary roads at lower cost.

Through the use of these road oils, road builders gain a flexibility that is invaluable to good secondary road construction. Because Standard road oils do not harden excessively, roads laid with these oils can be reworked easily when necessary.

To help road builders in their work of developing better secondary roads, Standard Oil has improved its road oils to provide better coating of aggregate, greater binding quality, faster setting, and blacker appearance. That means longer-lasting, better-looking secondary roads can be constructed in less time and at lower cost.

From any of Standard's four great refineries located throughout the Midwest, road oils and asphalt can be delivered promptly to your road-building job. You'll find a Standard Oil Asphalt Representative in your section of the Midwest. He's available and ready to help you at all times. You can contact him easily by phoning your local Standard Oil (Indiana) office. Standard Oil Company, 910 South Michigan Avenue, Chicago 80, Illinois.

STANDARD OIL

ROAD OILS

STANDARD OIL COMPANY **STANDARD** *(Indiana)*

"CATERPILLAR"

By-passing Sherman Hill grade

How a relocation job on the U.P. will speed west-bound rail traffic

For years the Union Pacific's long grade over 8,014-foot Sherman Hill in southeastern Wyoming has been known as an engine killer. It was to boost trains up that slope west of Cheyenne that U. P. built the famous "Big Boy" locomotives. Now the mighty helper engines are headed for the same fate as the buffalo. A new 42-mile main line, with easier grades, is being built to the south.

Railroad relocation accounts for a considerable share of U. S. construction right now. It is a natural consequence of the swing to Diesel locomotives—longer trains—longer passing tracks. The roads are doing some of this work with their own off-track equipment. In other cases, where more earthmoving must be done, construction firms are being called in. The Union Pacific project is probably the biggest of the lot. It will cost $16,000,000 and involves the moving of 2,500,000 yards of rock, 4,000,000 yards of earth.

When the two-year job is finished, the U. P. expects to cut 15 minutes from its west-bound running time and use main line locomotives all the way through.

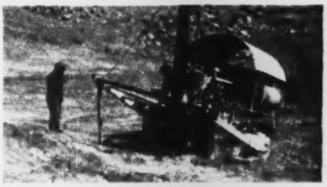
The contractors, Morrison-Knudsen Company, Inc., have assembled a big array of "Caterpillar" equipment on this job. "Cat" Diesel Engines power the shovels and compressors. Big yellow D8 Tractors, Bulldozers and Scrapers handle the shorter hauls. And speedy "Caterpillar" DW20 wheel-type Tractors, with No. 20 Scrapers, make eight round trips per hour over a one-mile haul distance.

These machines are constructing 111 major fills, up to 164 feet in height; installing hundreds of drainage culverts; and blasting through solid red granite to make cuts, one of them 140 feet deep and requiring the removal of 350,000 cubic yards of rock.

Morrison-Knudsen's reputation for putting big contracts through on time has a solid foundation in the tough, dependable "Caterpillar" machines that make up such a large proportion of the firm's equipment.

A "Cat" Diesel D397 Engine provides the lugging power for this Manitowoc [illegible]-yard shovel, making a cut for the new U. P. main line near Sherman Hill, Wyoming.

Worthington compressors, mounted on sturdy "Caterpillar" D8 Tractors, drill blast holes in rock for Morrison-Knudsen Co., Inc. ▶



One of Morrison-Knudsen's big, husky yellow "Caterpillar" DW20s and No. 20 Scrapers picks up a 20-yard load for a fast run to the fill. ▶

CATERPILLAR TRACTOR CO., PEORIA, ILLINOIS

Simplified construction
in sight

...with
MONOTUBE
cold-rolled
steel piles!

THE advantages afforded by Monotube piles in this major Canadian industrial project are well worth considering . . .

Although driving conditions were extremely tough—10 to 15 feet of heavy slag fill—over 3,000 Monotubes up to 80 feet long were driven with only light, mobile equipment!

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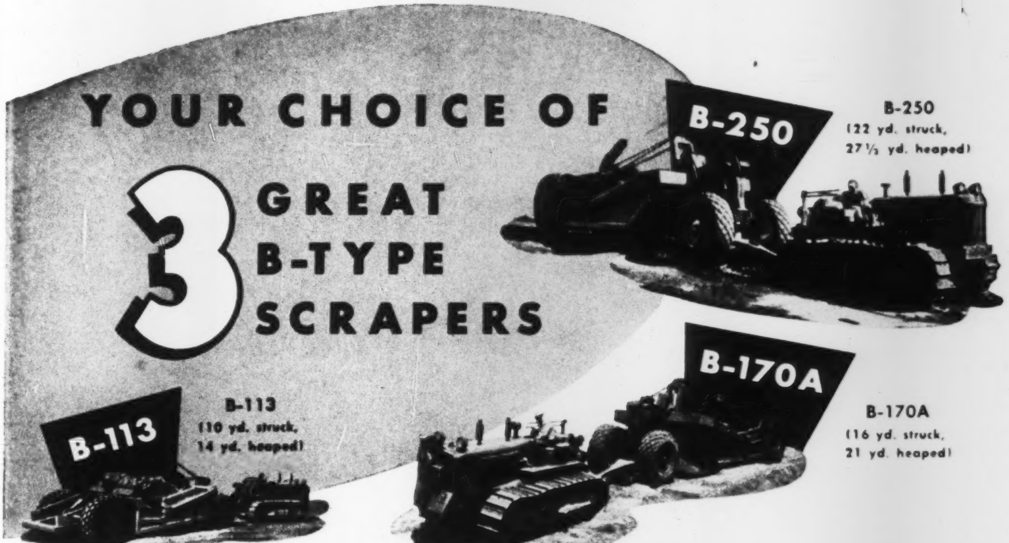
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Heavy-duty Texaco Asphaltic Concrete paving in Virginia's new Norfolk-Portsmouth tunnel serves...

1,000,000 vehicles in 80 days

READY FOR BUSINESS—Newly completed Norfolk - Portsmouth Tunnel, which is served by a hot-mix Texaco Asphaltic Concrete pavement, laid by Ames and Webb, Norfolk.

Photo Craftsmen, Inc., Norfolk

Virginia's new Norfolk-Portsmouth vehicular tunnel under the Elizabeth River was opened officially on May 23rd this year. Preliminary estimates of the tunnel's traffic proved to be on the conservative side. By August 10th—80 days after the opening—1,000,000 vehicles had passed through the new facility.

The pavement which serves the exceptionally heavy traffic of the Norfolk-Portsmouth Tunnel is hot-mix Texaco Asphaltic Concrete. It was constructed in two courses, having a combined thickness of five inches in the center, tapering off to two inches at the sides. The 22-foot wide pavement is divided into two lanes by colored tile blocks, six inches square, which are embedded in the asphalt mix.

Hot-mix Texaco Asphaltic Concrete paving is a sound investment wherever heavy traffic must be served. Its ability to absorb severe impact, its freedom from joints, low susceptibility to temperature changes and immunity to ice control salts, all contribute toward a long life with a minimum of maintenance and a low annual cost.

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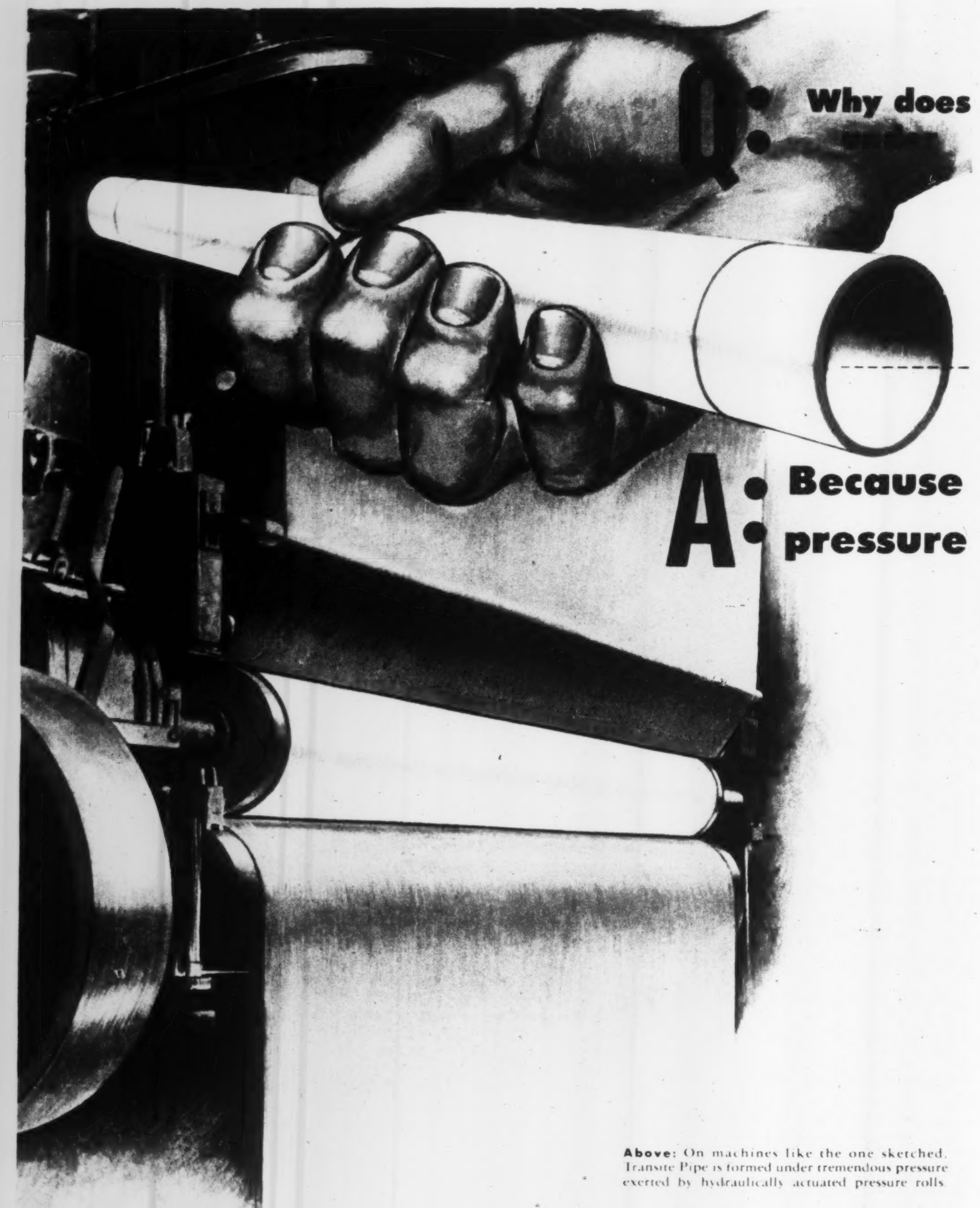

Q: Why does [illegible]
A: Because pressure

Above: On machines like the one sketched, Transite Pipe is formed under tremendous pressure exerted by hydraulically actuated pressure rolls.

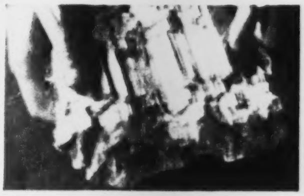
*Transite is a registered Johns-Manville trade mark

Johns-Manville TRANSITE

TRANSITE PIPE last longer these Texas city streets?

The water system in this fast-growing Texas city is a tribute to the lasting strength and corrosion resistance that enable Transite Pipe installations to outlast other pipe under busy city streets. The first Transite mains were installed here in 1939 to replace previously used pipe which had a service life of approximately seven years. So successful was this original installation that today, virtually the entire supply and distribution system consists of Transite mains.

it's formed under tremendous for lasting strength



Tough, strong asbestos fibers reinforce Transite Pipe—contribute to its exceptional corrosion resistance and lasting strength.

Yes, it's the all-important quality of *lasting strength* that enables Transite* Pressure Pipe to stand up under conditions highly adverse to ordinary pipe—as typified by the Texas city installation shown in the photograph above.

One of the reasons why Transite Pipe has this exceptional ability is the process used in its manufacture. On specially designed pipe-forming machines, the materials that go into its making—asbestos, cement and silica . . . are consolidated under heavy pressure into a tough, dense homogeneous pipe wall structure. And reinforcing this structure . . . distributed uniformly throughout each length of pipe . . . are countless indestructible fibers of asbestos with a tensile strength comparable to that of steel. *No wonder this modern asbestos-cement pipe is strong and stays strong through the years!*

And no wonder thousands of American cities and towns have found it the answer to today's need for a pipe that assures the greatest possible return on waterline investments. For in addition to those economies resulting from lasting strength, Transite Pipe also provides other important savings. Its light weight and easy handling reduce installation costs. Its tight, flexible Simplex Couplings cut down on costly leakage losses. Its smooth interior assures a high coefficient of flow (C = 140) and, because Transite cannot tuberculate, helps keep pumping costs permanently low through the years.

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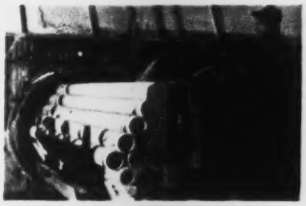

The pressure steam curing process—another reason why Transite Pipe survives corrosive attack and stays strong in service.

Transite's tight, flexible Simplex Couplings help relieve the line of excessive flexural stresses and safeguard against leakage and resulting undermining effects on water mains.

asbestos-cement PRESSURE PIPE

Main Street Merchant

The Golden Rule Store in Kemmerer, Wyoming, where J. C. Penney started his business in 1902. Now, fifty years and some 1624 stores later, comes Penney's beautiful new store on Monument Circle, in Indianapolis.

J. C. Penney's Great, New Indianapolis Store Gives Concrete Expression to Principles which Built an Ideal into a Billion Dollar Business

● Clearly, J. C. Penney meant it when he called his first store The Golden Rule, for he and his associates have built that precept into a nation-wide institution, with 1624 stores and over a billion dollars annual volume. One of the newest in the Penney chain is this handsome Indianapolis store, on Monument Circle, the hub of the world's largest city not on navigable water.

The durable, fire-safe character of the building's concrete construction is as staunch as the business it houses. Hailed as a fine example of modern architecture, this new $6-million building, with 182,000 sq. ft. of total area on three floors, is windowless and completely air-conditioned. Counter and display arrangements also strike a new note in design.

Here is a structure well expressing the traditions of quality, value and friendly service which are distinguishing attributes of the business it houses, as indeed they are of the company which produced the 25,000 barrels of Lone Star Cement that went into this construction.

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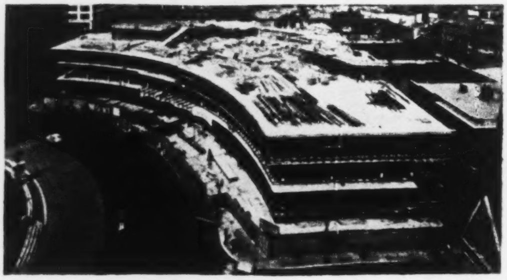
—all of Indianapolis, Indiana



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CIVIL ENGINEERING

DECEMBER 1952

THE MAGAZINE OF ENGINEERED CONSTRUCTION

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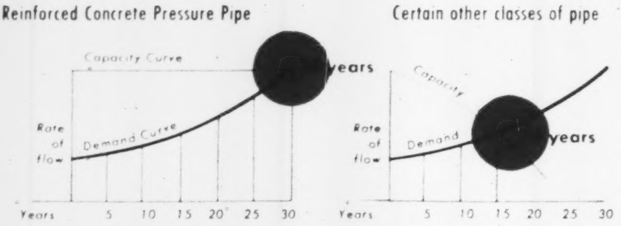
This is how Reinforced Concrete Pressure Pipe works for you in the FUTUR[illegible]...



TREMENDOUS GROWTH AND POPULATION GAINS have made many community planners and water works engineers realize that in order to satisfy future needs, their main water supply lines *must* have a high sustained hydraulic capacity.

An interesting example of foresight and long range planning is the program for enlarging the water system of the City of Burbank, California. Fully realizing that the post war years would bring unprecedented population gains to their area, the City Manager, the Planning Commission and the Engineers in the Public Service Department of the City of Burbank planned and installed additional permanent water mains in anticipation of future demands. These installations involved considerable footage of American Concrete Cylinder Pipe in sizes 16" through 36". The City of Burbank's water system totals approximately 230 miles and has reached multi-million dollar proportions.

SUSTAINED HYDRAULIC CAPACITY. The use of reinforced concrete pressure pipe manufactured by this Company assures to the City of Burbank and will also assure to your community superior design, permanence and sustained hydraulic capacity, the basic requirements of long range planning.

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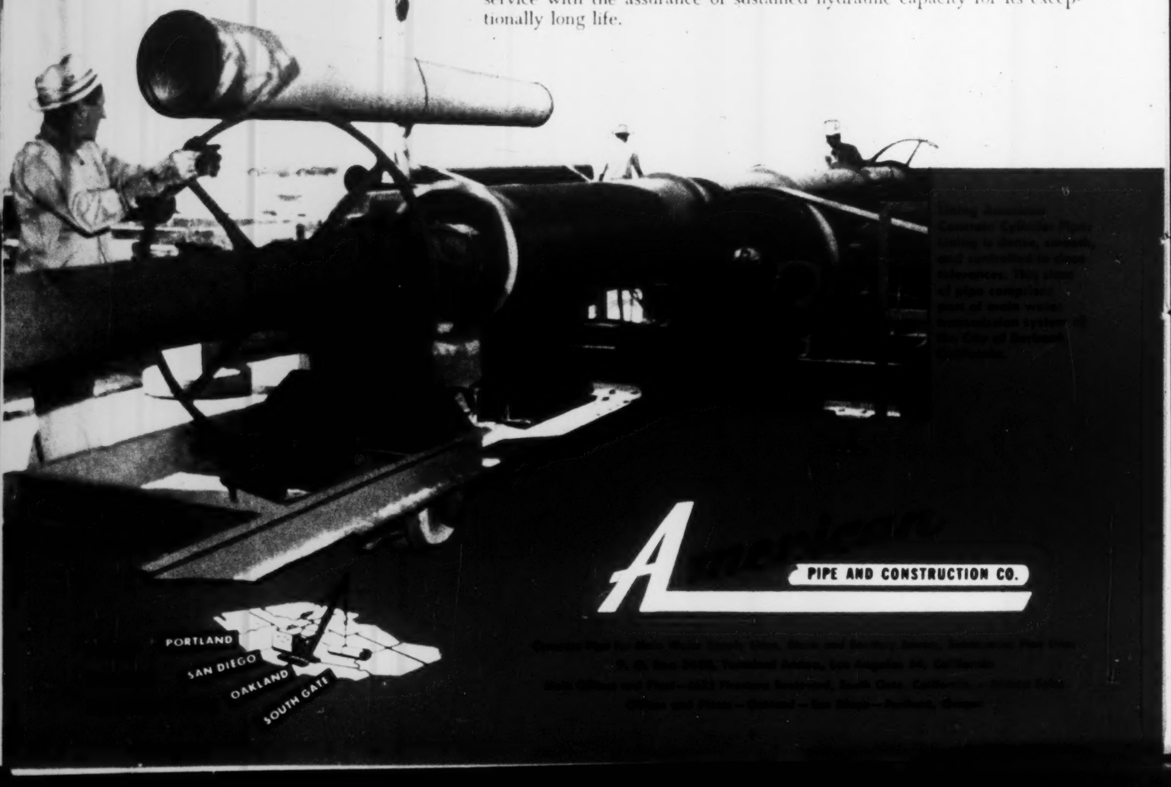

Lining American Concrete Cylinder Pipe. Lining is dense, smooth, and controlled to close tolerances. This class of pipe comprises part of main water transmission system of the City of Burbank, California.

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CIVIL ENGINEERING

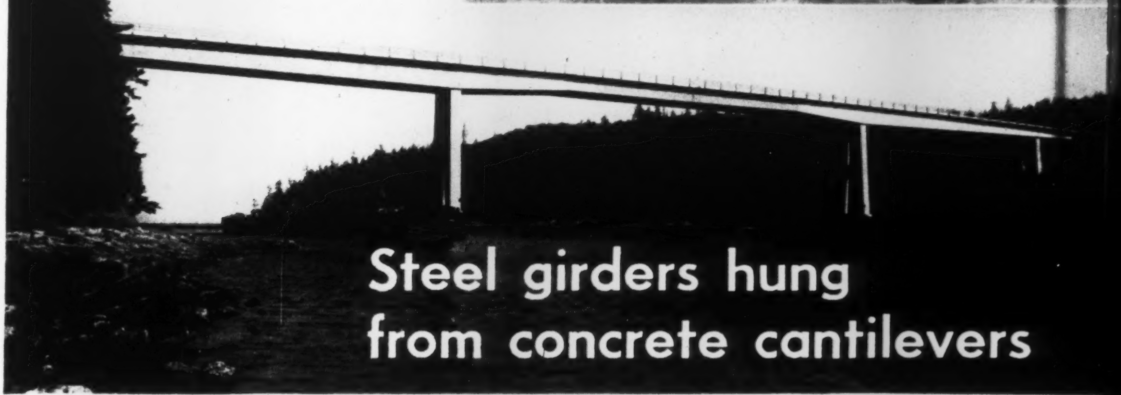
DECEMBER 1952

THE MAGAZINE OF ENGINEERED CONSTRUCTION

HOMER M. HADLEY, M. ASCE

Consulting Engineer, Seattle, Wash.

Completed concrete-box and steel-box bridge over Portage Canal costs $16.07 per sq ft of deck. Central span of 250 ft consists of 140 ft of suspended steel and two 55-ft concrete cantilevers.



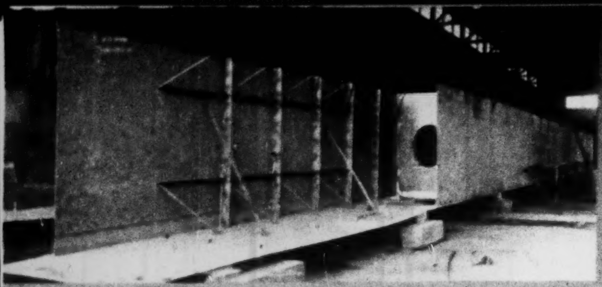
Steel girders hung from concrete cantilevers

Steel box-girders and concrete box-girders are successfully joined to span the Portage Canal in Washington. The bridge, with a maximum span of 250 ft, cost $16.07 per sq ft. The structure provides cheap, efficient service by replacing the previously existing ferry. The method of construction which was used to complete the 670-ft bridge is given in this article.

At the southern end of Port Townsend Bay, which is situated at the easterly end of the Strait of Juan de Fuca and the entrance to Puget Sound, lie two islands. They are connected to one another by a gravel bar and are separated from the mainland by a straight, narrow channel, known as Portage Canal, which is much used by small craft, log tows, and similar vessels. For a number of years the public ferry which has operated across this channel lost money to such an extent that the outlay to cover these losses would largely finance a bridge. It is pointless to comment on the superiority of bridge service over ferry service.

After prolonged effort, often under discouraging circumstances, and with a final contribution of defense funds, financing for the new bridge was arranged. Requirements included a minimum clear channel width of 240 ft; a vertical clearance of 60 ft at high tide; a clear channel width of 110 ft during construction; a 22 ft roadway; and H20 S16-44 loading.

The length of the bridge was determined by holding the toes of the



Designer finds 2-in. reinforcing bars, used over piers and elsewhere, invaluable for long-span girder construction, since they provide required steel areas with fewest number and widest spacing of bars.

Interior bracing of partially completed steel box-girder may be clearly seen in photo at left. Truss bars in each corner of box, welded as shown to webs, are welded to 4- x 3- x ¼-in. angles running along inside of top flange, and to 3- x ¼-in. plates running along inside of bottom flange.

Photo courtesy Redding's, Port Townsend, Wash.

end embankments practically at the top edges of the steep rock banks rising from the water's edge, with the top of the embankment slopes establishing the overall bridge dimension. The use of cantilever ends on the bridge brought the end bents as close together as was reasonably possible. This arrangement left a distance of about 600 ft to be spanned. An odd number of spans was made obligatory by the central ship channel requirement as well as for architectural reasons. There was therefore the possibility of having either a three-span or a five-span layout.

A truism of bridge design is that the greatest economy is achieved by having the cost of the substructure equal the cost of the superstructure. Although the fact is frequently overlooked, a considerable part of superstructure cost is in those parts that are unvarying. The same roadway slab and roadway slab reinforcement, the same curbs, sidewalks, and railings are required whether the span is 50 ft or 150 ft. In the case of a concrete box girder, the concrete of the bottom slab of the box and the local slab reinforcement are likewise constant, the variable elements being the additional concrete of the webs and cross webs, the web forms, and the main longitudinal girder reinforcement. It is evident, therefore, that fairly long spans are not uneconomical in cases where piers are high and require underwater work.

In this particular case it is obvious that introducing two more piers would have permitted readjustment and shortening of the approach spans and would have effected savings in the superstructure but, at the same time, would have very substantially increased the cost of the substructure, resulting in a costlier bridge. For

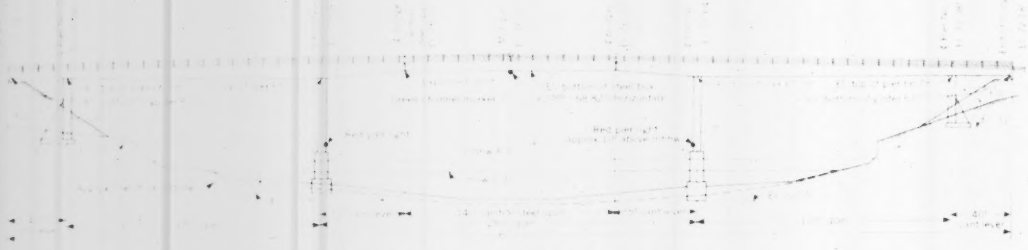


FIG. 1. Elevation of Portage Canal Bridge (above) shows how steel and concrete girders were united in single span to meet clearance requirements at minimum cost.

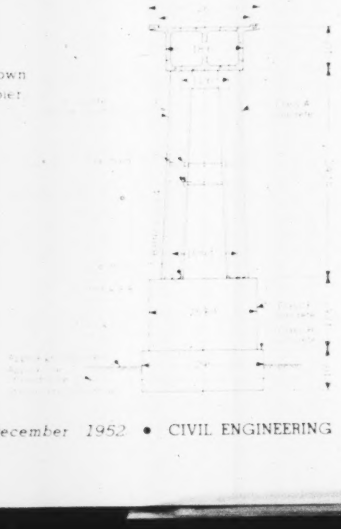


FIG. 3. Bridge's 670-ft length has four piers. Pier 2, shown at right in elevation, is similar to Pier 3, the other channel pier.

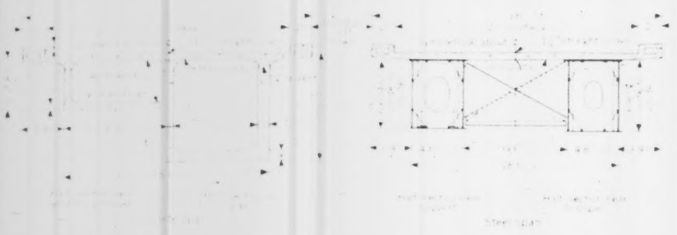
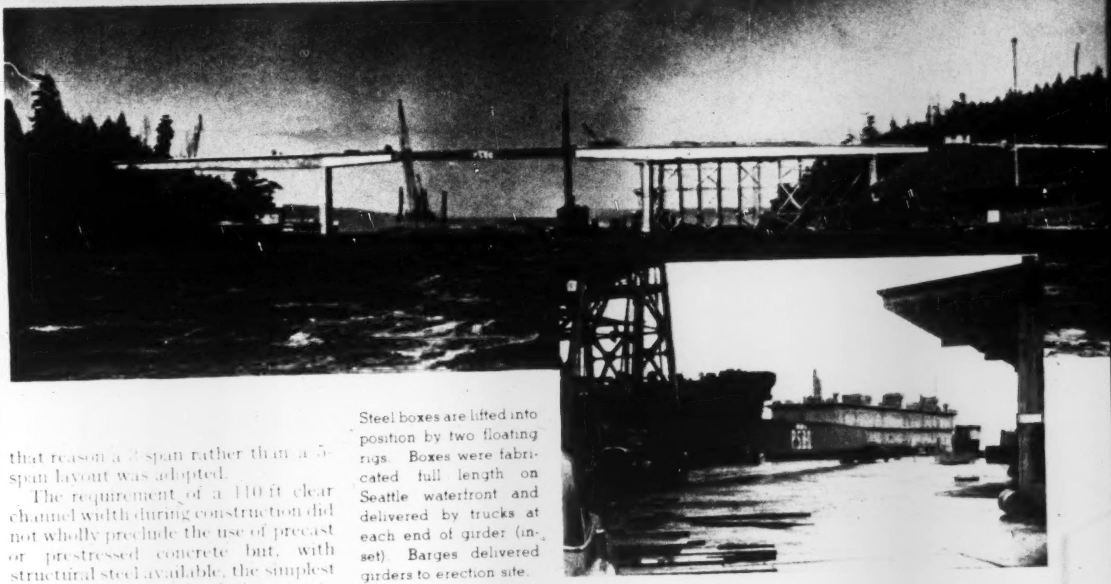


FIG. 2. Relative dimensions of girders are shown in half sections (above). Width of 18 ft 6 in., out to out of steel boxes, was governed by width of concrete boxes.



Steel boxes are lifted into position by two floating rigs. Boxes were fabricated full length on Seattle waterfront and delivered by trucks at each end of girder (inset). Barges delivered girders to erection site.

that reason a 3-span rather than a 5-span layout was adopted.

The requirement of a 110-ft clear channel width during construction did not wholly preclude the use of precast or prestressed concrete but, with structural steel available, the simplest and most economical solution was to use steel for the central part of the main span. Needless to say, its weight is far less than that of any concrete that might have been substituted for it and, in the middle of a 250-ft span, a saving in weight has more than passing significance.

The net result of various preliminary studies and estimates was the design shown in Fig. 1. The bridge consists of a central 250-ft span flanked by 170-ft spans beyond which project 40-ft cantilevers. Floating slabs, 15 ft long, supported by fill and by structure, complete the overall length of 700 ft. The central 140-ft length of the 250-ft span is carried by a pair of steel box girders, Fig. 2. The remainder of the structure except the end slabs utilizes concrete box-girder construction, Fig. 2. The overall width of the two-celled concrete box is 18 ft 6 in. Its depth at the ends of the inshore cantilevers is 5 ft. This increases to 10 ft at the channel piers, as shown in Fig. 3, and diminishes to 7 ft 3/4 in. at the ends of the 55-ft channel cantilevers where the steel box girders are suspended. The three webs attain a maximum thickness of 13 in. at the channel piers. The minimum web thickness of 8 in., together with other facts, identifies the work as a Federal Aid project. The main girder reinforcement over the channel piers consists of forty-nine 2-in.-sq bars spaced in a single layer quite uniformly across the roadway slab.

The concrete girders were poured first, on one side of the channel, then on the other, as follows:

(*a*) Bottom slab, webs and all transverse webs of the 170-ft span, center to center of piers

(*b*) Bottom slabs, webs and all transverse webs of the two cantilever ends

(*c*) Entire roadway slab, from end to end of the cantilevers

(*d*) Curbs, after all falsework had been released and the suspended span completed

Left to his own devices the writer never uses shear keys in construction joints since such pockets have smooth surfaces, catch dirt, cost money, and do not equal a well-roughened horizontal surface. However, shear keys were used here in all construction joints between webs and roadway slab. Nor did their use stop with these horizontal construction joints. They were also required in the vertical construction joints between the (*a*) and (*b*) pours listed above, which were centered on the piers. Not unless the piers themselves split asunder vertically and the separate halves settled unequally could any differential movement possibly occur in these joints. They were shear-keyed anyway.

The steel box girders are 4 ft 6 in. wide, 6 ft 6 in. deep at ends, and 6 ft 8 in. deep at mid-span. They are placed 18 ft 6 in. apart so that their outer webs are flush with the sides of the concrete box girders. In accordance with the minimum thickness rule, the webs are of 5/16-in. plate. The top flange varies from 3/8 in. to 1/2 in. in thickness and the bottom flange varies from 3/8 in. to 7/8 in. in thickness. The flange plates cantilever 3 in. beyond webs. Vertical stiffeners, 5 × 5/16 in., placed 3 ft 8 in. on centers, are used on inner faces of webs only. Horizontal web stiffeners, 3 × 1/4 in., placed 1 ft 6 in. below top flange and 1 ft 10 in. above bottom flange, are continuous for the full length of the girder. Five transverse diaphragms of 5/16-in. plate are provided, at mid-span and 22 ft center to center in each direction. Between diaphragms the four corners of the box are stiffened with 7/8-in. round trussing bars. The web contacts of these bars come at the junction of vertical and horizontal stiffeners; the flange contacts are midway between the web contacts and are located 15 1/2 in. in from the webs and welded to 4 × 3 × 1/4-in. angles, with the 3-in. legs vertical, extending longitudinally along the top flange. Plates, 3 × 1/4 in., are used on the bottom flange along the points of contact. The trussing bars, welded to webs and flange plates, form what are basically deep inclined trusses in the four corners of the girder. These inclined trusses span from diaphragm to diaphragm and of course greatly stiffen both webs and flanges.

Wherever, as here, a concrete roadway slab rests directly on a girder, with the shear connectors welded to the flange plates directly above the points at which the trussing bars have been welded to the flange plates, the stiffness of the roadway slab, added to the other elements, tends to fix at frequent points that zone in the webs which the Moisseiff-Lienhard paper regards as most susceptible to buckling. (See *Transactions*, ASCE, Vol. 106, 1941, p. 1,052.) Since the authors postulated a web completely lacking the bracing here provided, it must be left to others to explain why the authors' conclusion regarding the critical *a/d* point should be rigorously applied to this case. Rigorously applied it was, however. An extremely rigid girder was produced, having torsional strength unknown in a single web plate girder. The writer would have been well content to provide cross bracing between the two girders at two or three points, but it is provided at both ends and at every intermediate diaphragm. The connection of these girders to the ends of the concrete cantilevers is accomplished by links and pins, as shown in Fig. 4. The disparity of sizes between the several parts of these connections results from the great excess of shearing strength in the girder webs which their depth and thickness unavoidably creates. Thicker flange plates would have permitted shallower depths, but it is doubtful whether a shallower girder would have looked as well.

A few comments may well be written regarding the shear connectors used. They are semicircular straps of 1½ × ¼-in. material set in an inclined (30 deg) position and welded to the upper flange plates, one end directly over a girder web, the other end directly above the point of contact of the diagonal trussing bar inside the girder. Such straps act by direct stress as well as by bond, have a substantial vertical component, and are simple and economical. Similar bent plates were used by the late Andrew Munster, M. ASCE, in bridge work in Seattle during the 1920's.

FIG. 4. End details of steel girders show manner in which steel girder was hung from concrete cantilevers.

Regarding erection, it can be briefly said that the concrete parts were built in the customary manner on falsework. The steel girders were fabricated full length on the Seattle waterfront. They were ingeniously moved one at a time from shop to dockside on two trucks, one at each girder end, facing in opposite directions. The trucks alternately towed, trailed, and maneuvered the girder around sharp corners and between buildings to the dockside, where whirly cranes swung it on the barge for delivery to the site. At the site, the girders were lifted into position by two of the contractor's floating rigs. After cross-bracing was installed, forms were supported from the girders, and the roadway slab of 4,500-psi concrete was poured. Curbs, handrails and painting concluded the construction program. It is evident that, with all steel construction, much longer box girder spans than this are economically feasible.

Details of the four bids submitted are given in Table I. Fender and lighting systems, while necessary parts of this contract, are not an essential element of bridge cost. Therefore it can be stated that the contract price of the bridge is $292,542. Based on overall dimensions, this is a unit cost of $16.07 per sq ft. The bridge was opened to traffic on January 11, 1952.

The steel girders were fabricated by the Puget Sound Bridge and Dredging Co. of Seattle. Manson Construction and Engineering Co. of Seattle was the contractor. The bridge was designed by the writer. Construction was supervised by Keith Jones, Jefferson County Engineer, whose long and earnest advocacy of the bridge is largely responsible for its existence.

TABLE I. Items and Bids for Portage Canal Bridge Construction

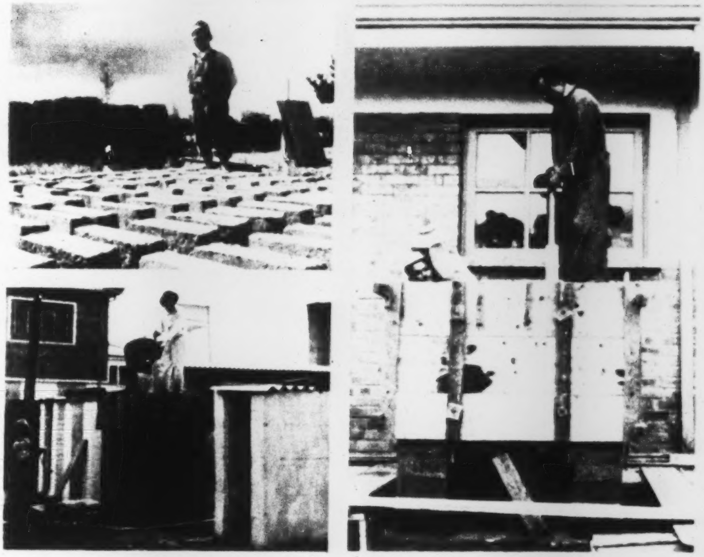
Quantity	Item	Bennett-Campbell	M. P. Butler	Manson Constr. and Eng.	MacRae Bros.
600 cu yd	Unclassified excavation	$ 10.00	$ 30.00	$ 12.00	$ 12.00
Lump sum	Shoring & cribs	40,000.00	15,000.00	28,000.00	38,200.00
Lump sum	Fender system	32,000.00	24,000.00	26,000.00	36,700.00
83 cu yd	Concrete, Class X	75.00	75.00	100.00	84.00
1,126 cu yd	Concrete, Class A	85.00	75.00	97.00	84.00
28 cu yd	Concrete, Class I	40.00	60.00	45.00	84.00
924 cu yd	Concrete, Class II	30.00	60.00	30.00	84.00
445,000 lb	Reinforcing steel	0.12	0.13	0.12	0.125
140,000 lb	Structural carbon steel	0.21	0.25	0.20	0.27
1,340 lin ft	Steel handrail	12.00	13.00	11.00	13.50
2	Reflector units	25.00	15.00	25.00	25.00
Lump sum	Lighting system	4,750.00	2,200.00	2,500.00	2,500.00
	Total	$321,245.00	$339,935.00	$321,042.00*	$362,360.00
Cost of fender and lighting system		$ 36,750.00	25,200.00	28,500.00	39,200.00
Cost of bridge only		$284,495.00	314,735.00	292,542.00	323,160.00

* Awarded contract.

Soil-cement for house construction

RALPH STONE, A.M. ASCE

Sanitary Engineer, Los Angeles, Calif.



Two methods of fabricating soil-cement are in brick form (left) and monolithically, by tamping in forms, as in two views of latrine construction at right. Both views are from engineering study carried out in Bogota, Colombia.

In a crisis caused by flood or bombing during war, conventional building materials are hard to obtain. Construction workers trained in specialized building trades are in short supply. Yet shelter and roads must be quickly provided. What is the responsible engineer to do? An investigation of low-cost building materials indicates that soil-cement is a possible material of construction. Soil-cement roads and subgrades have been used for over 20 years for highways and airports. Thus, civil engineers are well acquainted with the properties of soils as well as concrete and have the "know-how" to employ machinery and common labor for constructing soil-cement houses. Nevertheless, relatively little work has been done toward utilizing soil-cement mixtures for one-story structures.

In the Americas, it was the Spaniards who first introduced buildings made of "adobe" admixed with pigs' blood, lime, and other secret or long-forgotten ingredients. Beautiful missions, huge cathedrals throughout the world, and countless dwellings hundreds of years old remain as testimonials to the structural strength of these adobe soil admixtures.

Even today, adobe soil is used as a common building material in the southwestern United States, South America, Europe, and other lands. However, there are certain fundamental objections to fabricating with soil. First, adobe is eroded by water and crumbles when subjected to heavy rains or floods. Therefore, adobe homes require maintenance and are quite unsanitary unless the walls are protected by expensive coatings. Secondly, many sandy-type soils are weak in that they have no cohesive strength, while high clay soils shrink and crack too much on drying for building purposes. Only certain loams can form a satisfactory adobe.

At Bogota, Colombia, during 1949 and 1950, an engineering study was carried out for the Colombian government to evaluate the factors involved in utilizing soil-cement for building simple structures. It was found that small quantities of cement, as low as 2 to 8 percent by weight, stabilized most of the hundreds of soil types tested except those containing more than 85 percent clay as a maximum, or less than 10 percent clay as a minimum, or more than 8 percent organic matter. The soil-cement admixtures are erosion resistant and provide a considerably stronger structural material than adobe. These results were obtained from investigations which included the building of small trial field latrine units (as illustrated above) as well as soil laboratory studies.

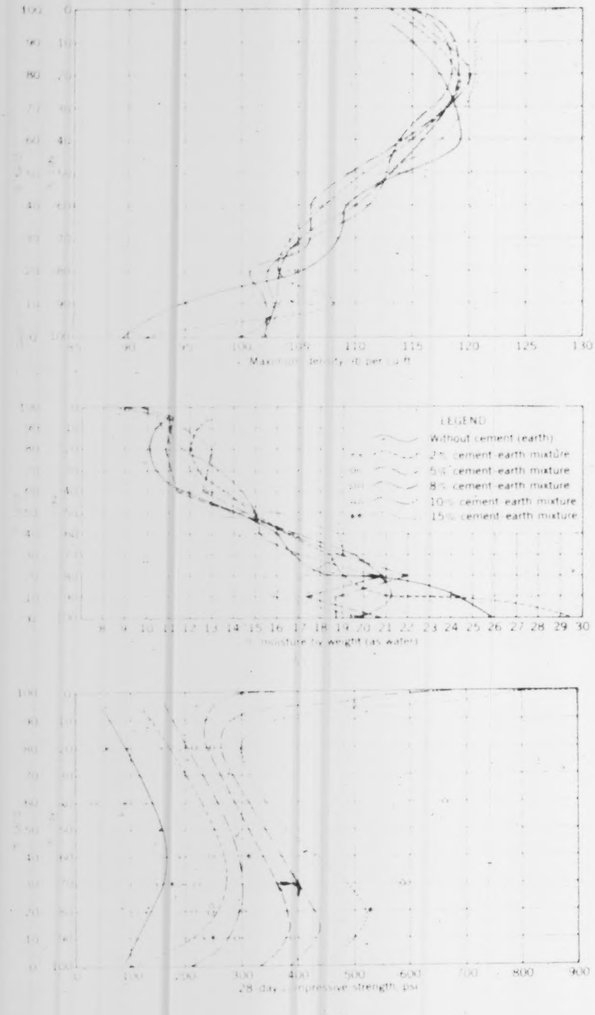


FIG. 1. Effect of varying proportions of sand, clay, and cement on maximum density (*a*), on optimum moisture to achieve maximum density (*b*), and on 28-day compressive strength (*c*), of standard Proctor cylinder samples

TABLE I. Screen Analyses of Different Earths Used for Preparing Soil Samples, in Percentages

	Sample 1 Clay	Sample 2 Earth
Percentage passing screen		
No. 10	[illegible]	[illegible]
No. 20	[illegible]	[illegible]
No. 40	[illegible]	[illegible]
No. 60	[illegible]	[illegible]
No. 100	[illegible]	[illegible]
No. 200	[illegible]	[illegible]
Percentage of sand	[illegible]	[illegible]
Density	[illegible]	[illegible]
Percentage of organic foreign matter	[illegible]	[illegible]

	Sample of Sand
Percentage passing screen	
¼ in.	100.0
No. 4	[illegible]
No. 8	[illegible]
No. 16	85.8
No. 30	71.8
No. 50	34.6
No. 100	22.4
No. 200	11.4
Modulus of fineness	1.71
Density	2.65
Percentage of organic foreign matter	0
Digested manure	
Percentage of organic matter	100

Field and Laboratory Investigations

The field work was done specifically to obtain construction experience with different soil-cement mixtures and varying fabrication techniques. The effect of wall thickness, reinforcement with steel or bamboo, and bricks versus tamped-in-place monolithic form construction were investigated. In the laboratory, Proctor cylinder samples were employed to ascertain quantitatively the optimum moisture, maximum density, compressive strength, moisture absorption, and resistance to erosion of soils containing varying percentages of sand, clay, cement, and organic material. The shrinkage limits and shrinkage ratios were also determined for these soils.

The soils studied were classified simply as sand or clay percentages rather than the more technical sand-silt-clay categories. It was thought that the data obtained would thus be more easily applied to practical field construction situations, where highly trained personnel are not available.

In order to work with a difficult type of soil representing a real challenge to the practicality of soil-cement construction, the field units were built with a soil having a high percentage of clay and organic matter. This soil analyzed as 94 percent inert material composed of 80 percent clay and 20 percent fine sand by weight. The other 6 percent was foreign organic matter. A pure sand, clay, or digested manure was admixed with this natural earth to prepare the test samples. Complete sieve analyses for these soils are given in Table I.

Fabrication Procedure

The recommended procedures for fabricating soil-cement would be as follows: first remove the top soil and root growth (normally a depth of 1½ to 2 ft is sufficient). Representative samples of the soil to be employed can then be cored and analyzed in the field or in a soils laboratory for optimum moisture, maximum density, compressive strength, and other structural characteristics with various admixtures of cement.

Armed with this knowledge, the prospective builder can apply himself with greater assurance to the task of house construction. The soil must be well broken up after it has been dug from the ground so that an intimate mixture of the soil and the added portland cement can be secured. The needed water for optimum moisture content is next added. The soil-cement mixture can then be used either to make bricks or to make monolithic tamped walls.

When wall forms are used, a 6-in.-deep layer of soil-cement is introduced and pounded in place by a hammer until a hollow sound is heard indicating maximum compaction. Additional layers of soil-cement are introduced until the form is filled. The form is then unbolted, placed on the previously tamped section of wall and the process continued until the wall is completed. Conventional concrete, including stud tie-bars may be employed for footings, top, hip, gable, and eave sections of the walls. Generally, a wall 10 ft high should have a minimum thickness of 10 to 12 in. at the base, tapering to not less than 6 to 8 in. at the top. Soil-cement can also be used for floors, although it should be surfaced with the equivalent of asphalt tile, ceramics, or concrete.

Conventional roofing and windows may be used. Wall plaster finishes can be applied, but many soils have a pleasing color and do not require any decoration. As for painting, conventional oil paints may not adhere, but cement-base and asphalt-base paints as well as whitewash are quite satisfactory.

Brick construction provides a nice surface texture that is architecturally pleasing. Bricks must be handled when first fabricated and then again when laid, whereas monolithic tamped walls require handling only once. Therefore, the latter are more economical, and furthermore, they can also be finished so as to provide a satisfactory, plaster-type surface.

The freshly constructed soil-cement should be protected from rapid dehydration to prevent checking and allow for the development of maximum strength. Soil-cement is a simple, intimate mixture of soil with measured amounts of portland cement and water, compacted to a high density. Therefore, unless proper curing takes place in the presence of water, the hydration strength of the portland cement cannot develop. A cement mortar patch serves to repair any failure caused by bad workmanship during construction, or by future accidents.

Compressive Strength of Soil-Cement

Most of the soil-cement samples with admixtures of as low as 2 to 5 percent of cement by weight were erosion resistant and maintained a 28-day compressive strength in the range of 200 to 400 psi. The soil-cement admixtures were closely twice the strength of the plain adobe soil construction. These data are shown in Fig. 1, which indicates that, with higher percentages of cement, there is greater compressive strength and a safety factor against bad fabrication. However, even with the lower percentages (2 to 5 percent), the erosion resistance and shrinkage ratios of the soil samples were quite satisfactory. Successful soil-cement construction is dependent on proper mixture of the soil and cement particles and on optimum moisture, maximum density, and good workmanship. Asphalt-stabilized soils have received considerable recommendation for adobe construction. However, asphalt does not add structural strength to the soil although it does make it erosion resistant.

In earthquake areas, lateral stresses are a particularly significant factor in structural design. In California, Peru, and Colombia, active earthquake regions, well-designed adobe structures have withstood all tremors. Soil-cement should be able to resist lateral stresses of 30 to 80 psi. Still, when desired, conventional steel reinforcing can be employed. In fact, barbed-wire mesh was experimented with and it was found to provide a superior bond between the soil-cement and the steel so that maximum reinforcement strength could be achieved.

Soil-cement also has the desirable properties of being fireproof and termite-free. Instead of deteriorating with time, age increases its strength.

Primitive adobe or soil-cement construction techniques require considerable hand labor. Where such low-priced labor is available, as for example in foreign lands, there is no need for labor-saving devices. However, the American engineer has available heavy earth-handling equipment that can reduce labor costs.

For these reasons it is believed that engineers will find it worth while to try soil-cement when planning for civil defense, when faced with a soil stabilization problem, or when a low-cost construction material is needed. They will be surprised at its economy and usefulness.

In the year 1949-1950, the author was a sanitary engineering adviser to the Ministry of Hygiene, Republic of Colombia, assigned by the United States Government through the Institute of Inter-American Affairs. Full acknowledgment is given to the financial assistance provided by these agencies. Dr. Gustavo Maldonado and Dr. Jorge Bateman, of the Engineering Materials Laboratory at the National University in Bogota, co-operated in the performance of these studies. Many other Colombian and American technicians have helped in this investigation.

Simple methods used in Bogotá investigation are illustrated by photos showing, from top downward, erosion test, moisture absorption test, and compression test in Swiss Amsler Universal testing machine. Bottom view shows result of erosion test, with undamaged soil cement sample at left and eroded "adobe" soil sample at right.

Engineers needed on new frontier

A. E. PERLMAN

Executive Vice-President, Denver & Rio Grande Western Railroad Co., Denver, Colo.

Having been privileged to associate intimately with engineers for most of my life, I have a deep respect for their ability and integrity. Engineers have brought America through the raw frontiers of science until today we have the greatest know-how and the highest standard of living in the world. Unfortunately, while we have made great strides in attaining the material comforts of life, we have neglected the field of human understanding. So, with faith in your intellect and analytical methods, I come to you engineers in the hope that you will exert your fine talents on a new frontier—the uncharted wilderness of human relations.

Scientific Frontier Developed

In going back in American history to find the basis for our success on the scientific frontier, it is interesting to note that the Plymouth Colony was founded with a completely socialistic economy. After a few years the Colony was on the brink of failure because the economic system offered no incentive to its members. In order to avert failure, ownership of land and the retention of its products were permitted each member of the Colony.

With this beginning of an American free enterprise system, the Colony prospered and our country, its boundaries pushed westward, grew and flourished. During the past century, American scientists set the pace for the rest of the world to follow.

First of all, this scientific revolution has brought with it a social revolution and a new definition of capitalism. The economic royalist of yesterday has been replaced by millions of share-owning Americans. At the same time, the revolution has taken us away from the days when a shoemaker took great pride in making a pair of shoes for a customer, and when a cabinetmaker, with his assistants, could furnish a home for one of his clients.

This scientific revolution has, secondly, taken us away from the personalized relationship between employee, employer and customer, into the age of the machine and into the society of the machine age. The society of this age is composed of manager, worker, union leader, and politician. The manager and the union leader, in their struggle for power, have permitted, in the meantime, the politician and the government bureau to hold the balance of power. The people have become servants of these elements, instead of these elements becoming the servants of the people.

As the Very Rev. William Ralph Inge, Dean of St. Paul's Cathedral, Washington, D.C., has warned, "The greatest danger to civilization is the increased power that science has given to governments. When they have once got control of the machinery they can suppress any exercise of the popular will."

Scientific developments, in the third place, have brought the world much closer together through better transportation and communication. We can now travel to Europe faster in a jet plane than we can reach many parts of our own state by automobile. These better transportation and communication facilities should, logically, bring the nations of the world to a closer understanding. But they have only served to make them more insecure. In spite of scientific advances the United States finds its free enterprise system in greater danger from within and without than at any time since the nation was founded.

Foreign Policy Needs Attention

To check this trend, we have, against all tenets of common sense, been attempting to buy friendship with other countries. The result has been extremely disillusioning.

In the past three years I have heard the same story in all parts of the world when I asked, "Isn't it too bad that the Russians are disturbing the peace of the world with their tactics?" People in other countries laughed and said, "The Russians are only trying to spread their imperialism, just as you Americans are trying to spread yours. They are doing it by spreading ideas, and you are doing it by throwing dollars around. They are doing a much better job than you."

Our approach to the peoples in other lands has been in many ways unfortunate. For one thing, very few of our ambassadors whom I have met in foreign countries have troubled themselves sufficiently to learn the language of the country in which they are living. They rely upon interpreters or else expect the "foreigners" to speak English to them. In Spain, two years ago, the Director of the Spanish Railways was kind enough to take me to his summer home in the Guadarrama Mountains, for a weekend. On the way back to Madrid he apologized for his wife's poor English. I told him that being in Spain I should apologize for not speaking her native language. He replied, "Oh, America is a rich country. You Americans do not have to learn our language, we must learn yours."

Instead of coming into a country and learning the problems of its people with understanding, we come in like a rich mother-in-law who has helped furnish the children's house. We tell these countries in effect, "You are backward children, you must improve your sanitary conditions, you must join labor unions, you must support the political party which is looked upon favorably by the government of the United States." And so on down the whole nagging list of "you must's." That kind of mother-in-law has become a character to be ridiculed on the American scene, and yet that is exactly how we have projected ourselves to other nations.

We forget that three-fourths of the world's people are colored, and that the white population is the minority group. High-born citizens of India, coming here to study, visit or lecture, make certain to wear distinguishing Indian garb so that they can eat and sleep in our hotels. Chinese are not permitted to own land and we treat the colored groups in our own country as inferior. Is it any wonder that the Japanese, the Chinese, the Asiatic Russians, and the people of India and Africa do not welcome the benevolent citizens of America with open arms?

Although we have become a great and powerful country, we must live together, in the family of nations, in peace and understanding. Only in this way can science be used to increase standards of living, rather than to build machines for the destruction of civilization.

A great moral and spiritual philosophy was enunciated when our founding fathers wrote the Constitution and the Bill of Rights. People in other lands were given a star a great ideal to follow. With changes in our economy we have moved farther and farther away from those principles, until today our domestic and foreign policies are not based on human understanding, but on expediency. We do not necessarily support the democratic heads of a state but those who will be of the greatest assistance in today's power politics.

Methods of Opening New Frontier

What can be done about this situation? It is my thought that our frontiers in human understanding must be given the same intelligent effort that men of science have given research in physics, chemistry, mathematics and like endeavors. While the physical sciences have exploded across the raw frontiers into maturity the social sciences are still in their infancy.

Men of science must explore more exhaustively the whole wonderful human machine. We must dispel the old notion that everyone is created equal and learn something about the differences in each machine. We would then have a greater understanding of people.

Let us learn more of human relations in our schools, even at the expense of geodesy or stereotomy. Then we as engineers can learn to work with people, as well as with mathematics and materials.

Let us become more proficient in expressing ourselves orally and in writing, and take seriously our obligations as citizens of our community, state, nation and the world.

We must take a greater part in civic activities so that a small group of politicians will not hold the balance of power in our economy.

We must give more time to our children study the needs of our schools and their instructors. In Colorado more taxes were collected last year for old-age pensioners and social security than for the education both of children and adults. In Denver, a city which boasts of its progressive education, 2,288 children can only go to school half a day because there isn't room for them to go full time.

Let us attempt to achieve better understanding among the various social, economic and racial strata of our own population. This can be done by taking the time to understand the needs and desires of our many and different fellow citizens, who are all striving for a better way of life. The differences lie in their approaches to life's problems. We must help them with sympathetic tolerance and a true desire for their welfare.

With our talents so directed we can insure an American philosophy rededicated to the Constitution and the Bill of Rights. We can make sure that the coming generation is given more than material comforts for which to live. The Hisses and Remingtons did not lack these material comforts when they were fired with zeal for other ways of life.

Let us instill in our children a great enthusiasm for our way of life and renewed faith in spiritual rather than materialistic philosophies. Our children too must have a star to follow, as our Founding Fathers had.

I have tried to expose the new frontiers objectively, but they are still uncharted. I am certain that for you engineers, with your great American heritage and scientific approach, no problem will be too difficult. Since "impossible" is not in your vocabulary, you need only the desire. You have brought this country through a scientific revolution which has made it the greatest industrial machine on the face of the earth. You have made us the greatest military and economic power in the world.

When you use that same intelligence and energy to develop this last and most challenging frontier and give to the humanities the intensive thought and research you have given to the sciences, you will give us a world in which we can all live freed of fears by love and understanding.

(This article has been abstracted from the paper, "Our New Frontier," presented by Mr. Perlman at the opening session of the Denver Convention. Carlton S. Proctor, Past President ASCE, presided.)

How would you do it?

Some of the most fascinating chapters in the life and memory of an engineer are those which deal with the unusual and unexpected situations which almost got him down but from which he finally emerged the victor. H. J. Gilkey

Piers for small bridges often consist of steel shells, 2 or 3 ft in diameter, which are filled with concrete. At times, under lax inspection, contractors have filled such shells with aggregate minus the cement, placing a concrete cap on the more or less well-compacted filler material. Does such an evasion of specified practice actually constitute a hazard to the safety of the bridge? For solution, see page 93.

Editor's Note. This is the ninth installment of a series which started in the February 1952 issue of Civil Engineering. In the April issue an article, "The Unexpected in Engineering—The Bugs," explains the project and enlarges upon the central theme that problems of the past created the practice of the present, that "The engineering of today rests upon a coral reef, sturdy remnants of yesterday's bugs." The process is a continuing one; there will always be today's and tomorrow's bugs to add zest and gray hairs to the practice of a profession that by its very nature must cantilever from a codified past to an untried future. "Long live bugs" is an ever-present challenge to the virility and ingenuity of the engineer. If you have a good bug, why not share it? H. J. G.

TWO PRECAST SUBAQUEOUS TUNNELS—

Elizabeth River and Baytown tunnels compared

S. STEUERMAN and H. ALDEN FOSTER, Members ASCE

Respectively Design Engineer and Principal Associate, Parsons, Brinckerhoff, Hall & Macdonald, New York, N.Y.

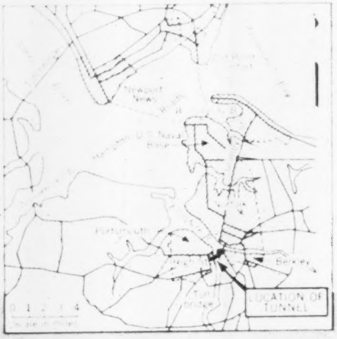
The art of designing and constructing subaqueous tunnels by the trench and precast method was well developed in the United States and abroad between 1906 and 1948. In this 42-year period nine tunnels of this general type were designed and constructed by various methods, as outlined by S. A. Thoresen in CIVIL ENGINEERING for January 1950 (p. 36). Within the past three years, two similar tunnels have been built, both designed by the same firm of engineers—Parsons, Brinckerhoff, Hall & Macdonald. These are the Baytown Tunnel now under construction under the Houston Ship Channel at Baytown, Tex., and the Elizabeth River Tunnel, recently completed between Portsmouth and Berkley, Va. The designing firm had had previous experience with this type of construction, through the design of the Detroit-Canada Tunnel in 1928–1930. For previous articles on the Baytown Tunnel, see Mr. Thoresen's article referred to above and the articles by J. O. Bickel and M. P. Anderson in CIVIL ENGINEERING for March 1951 (p. 30). For the Elizabeth River Tunnel, see *Engineering News-Record* for Nov. 16, 1950 (p. 44), and May 22, 1952 (p. 44).

Since the Baytown and Elizabeth River tunnels are similar in size, each having two lanes with a 22-ft-wide roadway and a minimum clearance of 14 ft above the pavement, they furnish an opportunity to show how the design was adapted to local conditions, topography and geology and to the available contractor's equipment.

The Baytown Tunnel was constructed as a reinforced concrete tube inside a steel cylinder with a radius of 17 ft 5 in. The Elizabeth River Tunnel was also constructed inside a steel tube (radius 15 ft 8 in.), but was provided with an exterior steel box of octagonal section for ballasting during and after sinking in place. The reasons for these differences in design are explained below.

Subaqueous tunnels of this type are expensive to construct, averaging $2,500 per lin ft; hence it is essential to make the structure as short as local conditions will permit. In order to compare the two tunnels as regards overall lengths, a theoretical formula can be set up to show the length of an ideal structure, built in an unimproved area where the minimum length is determined by the width and depth of the water channel above the tunnel and the allowable slope of the tunnel roadway (Fig. 1).

The portals of a tunnel are normally located at the point where the


Newport News
Naval Base
Portsmouth
Berkley
Toll bridge
LOCATION OF TUNNEL
0 1 2 3 4
Scale in Miles

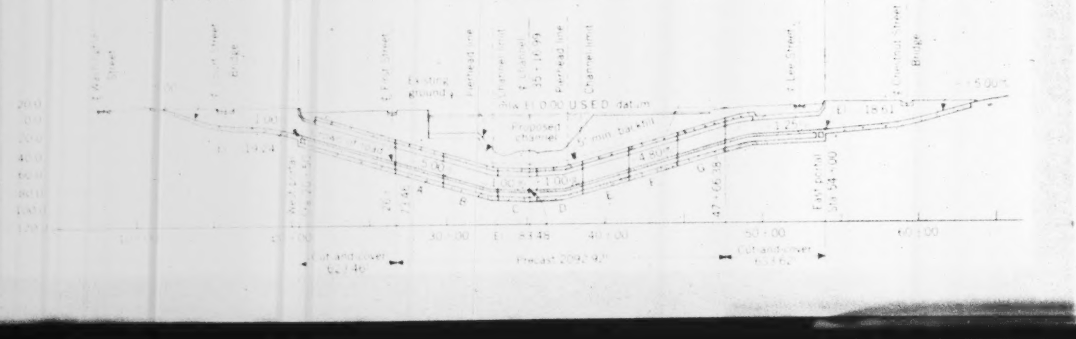

Open approach
Portal to portal 3350.00'
Open approach
Existing ground
Bulkhead line
Channel limit
℄ channel 35+16.99
Bulkhead line
Channel limit
Proposed channel
5' min. backfill
MLW El. 0.00 U.S.E.D. datum
℄ Lee Street
℄ Chestnut Street
Bridge
West portal
East portal 54+00
A
B
C
D
E
F
G
1.00%
5.00%
4.50%
1.00%
30+00
40+00
50+00
60+00
Cut and cover 612.46'
Precast 2092.92'
Cut and cover 653.62'

FIG. 2. ELIZABETH RIVER TUNNEL location map and profile. Precast tube sections are referred to on profile as A, B, C G.

In Fig. 1, the following notations are used:

W = width of full depth navigation channel

D = depth of channel below lower low water (L.L.W.)

C = minimum depth of protective fill over top of tunnel (usually 5.0 ft)

H = difference between higher high water (H.H.W.) and L.L.W. in channel

T = vertical distance from road surface in tunnel to top of tunnel (approximately 25.0 ft)

G = maximum allowable gradient of tunnel roadway

L_p = length of precast part of tunnel

L_c = length of cast-in-place part of tunnel

L = overall length of tunnel, portal to portal = $L_p + L_c$

L_a = length of U-shaped watertight open approaches to portals

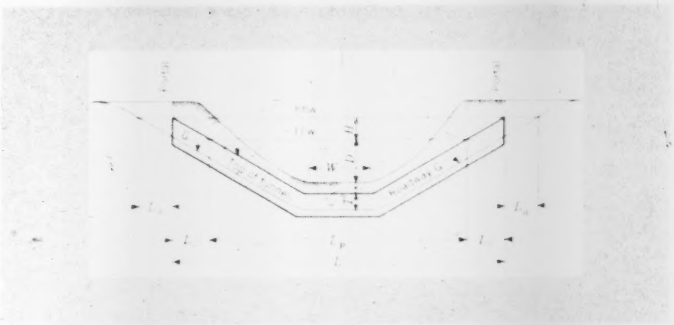

Portal
Portal
HHW
LLW
H
D
W
C
T
Top of tunnel
Roadway
L_a
L_c
L_p
L

FIG. 1. Theoretical trapezoidal profile (no scale) for a tunnel is used as basis for comparing lengths of Elizabeth River and Baytown tunnels.

top of the tunnel intersects the H.H.W. level. The portal-to-portal length is subdivided into two parts—precast and cast in place. Once the facilities and equipment for construction and sinking of precast sections are provided, the cost per linear foot for an additional length of precast structure is considerably less than for cast-in-place construction. Therefore the precast sections should be used for the maximum possible length. The natural limitation on the length of the precast tunnel is given by the depth of water necessary for floating in and sinking the precast section. The intersection of the top of the tunnel with the L.L.W. level may be assumed for this limit.

Of course the open approaches must be extended to the point where the tunnel roadway intersects the H.H.W. level. If the maximum slope of the roadway is maintained from the portal to the intersection of the roadway with this water level, the length of each approach would be T/G. Usually a vertical curve is provided at the outer end of each open approach, if the slope of the roadway is changed after reaching the H.H.W. level. Therefore the total length of the two approaches will generally be greater than $2T/G$.

With these assumptions and simplifications, the theoretical minimum length of the tunnel and approaches may be determined as follows:

$$L_p = W + \frac{2(D + C)}{G} = W + 2(D + 5)/G \quad (1)$$

$$L_c = 2H/G \quad (2)$$

$$L = W + 2(D + C + H)/G = W + 2(D + H + 5)/G \quad (3)$$

$$L_a = 50/G \quad (4)$$

Equations 1 to 4 determine the minimum length of a tunnel. In actual practice this length is often exceeded, owing to the impossibility of making full use of the allowable slope of roadway throughout the length of the project.

Length of Two Tunnels Compared

Location maps and profiles of the tunnels are shown in Figs. 2 and 3. In Table I are listed the controlling

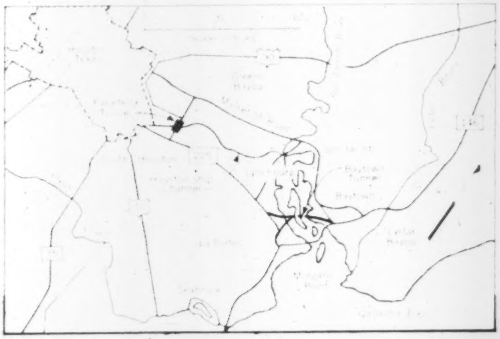

Baytown Tunnel
Baytown
Cedar Bayou
La Porte
Seabrook
Morgans Point
Houston Ship Channel
Galena Park
Pasadena
Lynchburg
146

FIG. 3. BAYTOWN TUNNEL, location map and profile. This tunnel was discussed in more detail by S. A. Thoresen (Civil Engineering, Jan. 1950, p. 26).

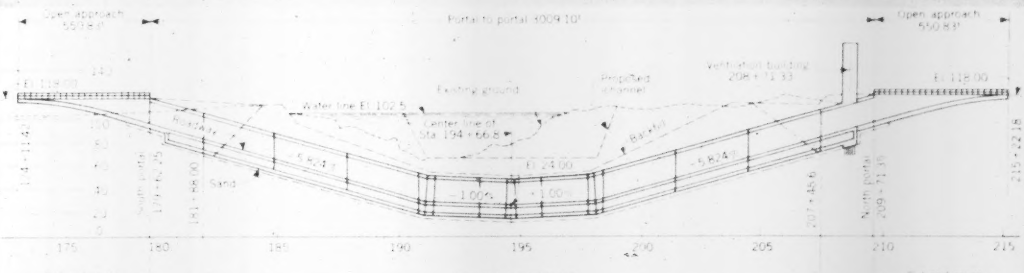

Open approach 550.83'
Portal to portal 3009.10'
Open approach 550.83'
El. 118.00
El. 118.00
Existing ground
Proposed channel
Ventilation building 208 + 71.33
Water line El. 102.5
Center line of Sta. 194 + 66.8
Roadway
Backfill
−5.824%
−5.824%
El. 24.00
−1.00%
+1.00%
Sand
174 + 11.42
South portal 179 + 62.25
181 + 88.00
207 + 45.6
North portal 209 + 71.35
215 + 22.18
140
120
100
80
60
40
20
0
175
180
185
190
195
200
205
210
215
Cut-and-cover Section 225.75'
Precast tubes 2557.60'
Cut-and-cover Section 225.75'

TABLE I. Controlling Data for Elizabeth River and Baytown Tunnels

	Elizabeth River		Baytown	
	As Is	Formula	As Is	Formula
Length of tunnel				
Precast part (l_p)	2 092 ft	2 650 ft	2 557 ft	2 420 ft
Cast in place part (l_c)	1 258 ft	400 ft	452 ft	620 ft
From portal to portal (l)	3 350 ft	3 050 ft +	3 009 ft	3 040 ft
Open approaches (l_a)	1 900 ft	1 000 ft +	1 102 ft	1 000 ft +
Length including approaches	5 250 ft	4 050 ft +	4 111 ft	4 040 ft +
Ship channel dimensions				
Width (B)	500 ft		700 ft	
Depth to M.L.W. (D)	40 ft		45 ft	
Max. change in water levels (H)	10 ft		18 ft	
Slope of road (s)	5 %		5.824 %	
Number of precast sections	7		9	

data, together with the lengths of the different tunnel sections, both actual and according to the theoretical formulas, Eqs. 1 to 4.

Examination of Table I shows that for the Baytown Tunnel the actual lengths agree closely with the theoretical, whereas for the Elizabeth River Tunnel great discrepancies occur. This difference is explained by the fact that the Baytown Tunnel was built in an unimproved area, while the approaches of the Elizabeth River Tunnel at both ends must pass under existing streets in the congested areas of Portsmouth and Berkley. The main reason why the portal to portal length of the Elizabeth River Tunnel is 10 percent greater than the theoretical is that it is necessary for the cast in place tunnel to pass under the railroad and Lee Street at the Berkley end.

The most significant deviation from the theoretical length at Elizabeth River is the shortening of the precast tunnel and the corresponding lengthening of the cast-in-place structure. At Baytown, all trenches could be excavated with natural side slopes without sheeting, and the actual length of precast tunnel exceeded the theoretical by 137 ft. At Elizabeth River, however, the congested areas at Portsmouth required sheeting of the trenches for a length of 844 ft with a depth ranging from 63.5 to 74.5 ft below M.L.W. The great depth of sheeted trench led the designers, in their original studies, to propose the construction of a 900-ft long section of shield-driven tunnel under compressed air. A price analysis, however, showed that the cost per linear foot for this construction would be prohibitive because of the short length involved. Recognizing the progress achieved in recent years in techniques of lowering the groundwater table, the designers then proposed that this part of the tunnel be cast in place in a sheeted dry trench.

This procedure subsequently was modified at the suggestion of the contractor, who was experienced in naval and salvaging work. He subdivided the 900-ft section in two parts, using a sheeted trench for the full length but lowering the ground water only for 622 ft at the landward end of the trench by means of four deep wells located outside of the trench. (See "Deep-Well Pumps," *Construction Methods and Equipment*, Nov. 1951, p. 48.) The part of the trench at the river end was not unwatered, and in this section the tunnel was constructed by moving a precast section in from the river.

Since the deep trench required extensive bracing and the deepest bracing was located below the water surface, this first precast tunnel section at the Portsmouth side had to be towed into place under the bracing in a submerged state. The successful completion of this operation, which demonstrated the ingenuity of the contractor, was surely a "first" in the history of the construction of precast subaqueous tunnels. It will be described in more detail in subsequent paragraphs.

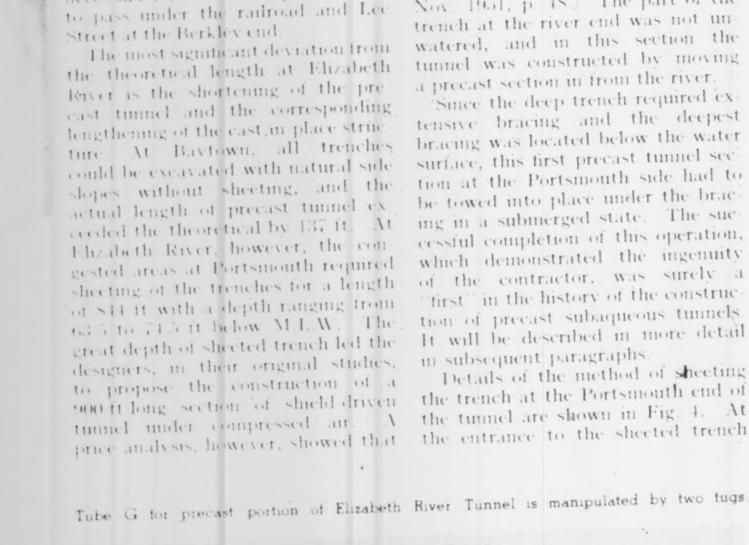
Details of the method of sheeting the trench at the Portsmouth end of the tunnel are shown in Fig. 4. At the entrance to the sheeted trench from the river, four sheetpile cylinders were constructed and filled with sand, to eliminate the necessity of bracing. This sheeting had to be driven to a depth of about 90 ft below mean low water. A short distance shoreward of the sheetpile cylinders, a double sheetpile bulkhead was driven across the sheeted trench and filled with sand to form a cofferdam ("A" in photographs) for the protection of the dewatered trench. On completion of the cast-in-place section this bulkhead was removed so that water filled the trench. The connection between the last precast section and the cast-in-place section was made under water.

Sinking the Precast Sections

It frequently occurs during the construction of precast tunnels that the density of the water near the bottom of the trench increases because of the inflow of water having higher salinity or carrying silt or other material in suspension. Therefore it is essential that, when the precast section is lowered to the bottom of the trench to the final position, it should have a total weight considerably in excess of buoyancy, in order to prevent subsequent heaving. After the backfill has been placed around and over the top of the tunnel, the additional weight makes the tunnel safe against any possible uplift. The problem, however, is to provide enough weight immediately after sinking of the section. Experienced contractors generally insist on having 1½ to 2 tons per lin ft of positive (submerged) weight, which for a section 300 ft long requires a weight above buoyancy of 450 to 600 tons.

Two methods are available for providing this load of 600 tons—to include it as ballast in the section before sinking, or to add a large part of it immediately after sinking of the precast section. The choice depends mainly on the available equipment for lowering the tunnel section in the water. The contractor for the Elizabeth River Tunnel possessed floating derricks which were very handy for sinking the sections, but could not handle very large loads. The contractor for the Baytown Tunnel, on the other hand, had to depend on the use of pontoons and barges, a less mobile type of equipment but able to handle greater loads. As a result, at Baytown the precast sections were 400 tons heavier than their buoyancy at the time of sinking. At Elizabeth River, the sections weighed only 100 tons above buoyancy and had to be ballasted immediately after sinking.

Tube G for precast portion of Elizabeth River Tunnel is manipulated by two tugs.



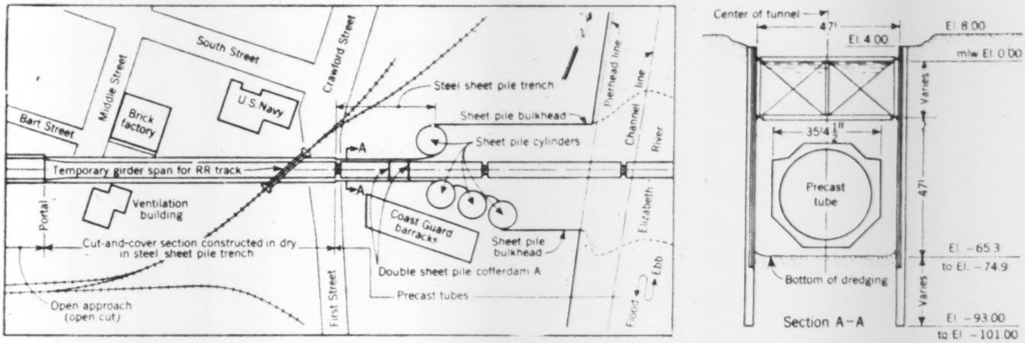

South Street
Middle Street
Crawford Street
Bart Street
Brick factory
U.S. Navy
Steel sheet pile trench
Sheet pile bulkhead
Sheet pile cylinders
Pierhead line
Channel line
River
Elizabeth
A
A
Temporary girder span for RR track
Ventilation building
Portal
Coast Guard barracks
Sheet pile bulkhead
Cut-and-cover section constructed in dry in steel sheet pile trench
Double sheet pile cofferdam A
Precast tubes
First Street
Open approach (open cut)
Flood
Ebb
Center of tunnel
47'
El. 4.00
El. 8.00
mlw El. 0.00
Varies
35'4 1/2"
Precast tube
47'
El. -65.3 to El. -74.9
Bottom of dredging
Varies
Section A-A
El. -93.00 to El. -101.00

FIG. 4. Details of sheeted trench at Portsmouth end of Elizabeth River Tunnel are seen in plan. Section through flooded trench indicates method of placing last precast tunnel section under bracing in submerged state.

bringing the total submerged weight up to 600 tons.

This difference in equipment led to an important difference in the cross sections of the precast tubes. For the Baytown Tunnel two different sections were designed—the S-section, which was circular in exterior shape, and the T-section, which had an octagonal shape containing pockets for placing ballast after submergence. The bidders were free to submit proposals on either of these sections; the winning bidder elected to use the circular section.

At Elizabeth River, the contractor chose the octagonal section which, though more intricate and more expensive to fabricate, has the advantage of having pockets which can be filled with tremie concrete immediately after sinking. This means that the section can be relatively light at the time of sinking and readily handled by floating derricks.

Although the T-section is an octagon on the outside, it is designed as a circular section disregarding the small differences in distribution of pressures on an octagon and on a circle. At the top and bottom of the tube, the section is in compression at the outside under final loading. Since tremie concrete was excluded as a structural part of the tube, the top and bottom of the tube were concreted in the dry, leaving pockets at the sidewalls to be filled with tremie concrete after sinking. At the sides of the tube, the exterior of the structure is subject, under final loading, to tensile stresses which are taken by the steel ribs of the section. The tremie concrete protects the ribs against corrosion.

It has been claimed in a recent European publication ("Der Neue

At Portsmouth end of Elizabeth River Tunnel, cast-in-place construction was used in dewatered trench for length of 622 ft. In top view, taken from roof of Coast Guard building (see Fig. 4), temporary girder span for railroad crossing appears in foreground.

At river end of sheeted trench on Portsmouth side of Elizabeth River, four sheetpile cylinders were driven and filled with sand to eliminate necessity for bracing. In middle view, driving of sheetpiling has been completed for master trench and for double cutoff wall, A, across trench. In bottom view, cylinders have been filled with sand and capped with concrete for greater stability. Double cutoff wall, A, has been filled with sand. This wall was for protection of work in dewatered trench to left, and had to be removed before last precast tunnel section was pulled into place under bracing in submerged state. See Fig. 4.

Verkehrsweg Osterleden in Stockholm, K. O. Biel and M. E. Fechtinger, *Die Bautechnik*, April May 1951) that an elliptical section is better adapted to resist the non uniform water pressure on a subaqueous tunnel. It may, therefore, be appropriate to explain why a circular section was selected for both the Baytown and the Elizabeth River tunnel.

The loading on a subaqueous tunnel in its final position may be subdivided as follows: (1) weight of tunnel, (2) water pressure on the tunnel, and (3) vertical and horizontal pressure of backfill above and surrounding the tunnel.

In a deep subaqueous tunnel with 5 ft of protective backfill above the top, stresses in the tube produced by the backfill are relatively small. In any case, before the backfill is placed, the tube has to resist the combination of loadings (1) and (2), and the optimum tube section is selected for this combination of loads.

The water pressure on the tunnel may be subdivided into: (1) non uniform pressure, resulting from variation in head of water between top and bottom of tube, and (2) uniform pressure, due to head of water above top of tube.

When the circular tunnel section is floating awash, the weight of the tube is balanced by the non uniform water pressure (buoyancy). Any additional weight resulting from roadway structure, ballast, etc., in excess of the buoyancy is taken by the cables on which the section is supported. If the thickness of the shell of the tube is insufficient to provide the weight required to overcome buoyancy, additional dead load inside the tube must be provided to permit submergence. This is usually the case: approximately 80 percent of the buoyancy is generally taken out by the weight of the tube.

It is possible to prove that a circular tube with uniform wall thickness sufficient to balance out the buoyancy will not be subject to any bending moments from the variable water pressure. Such a tube will be subject only to compressive stresses regardless of the depth of submersion. Thus the 80 percent of the buoyancy supporting the weight of the circular tube does not produce any moments in the structure. The remaining 20 percent of the dead weight of the tunnel section, combined with 20 percent of the buoyancy, produces only relatively small moments in the tube. Greater depth of submergence will only increase the compressive stresses in the shell without changing the moments. As long as the tension stresses in the reinforced concrete are critical, the deeper the tube is sunk the safer the structure will be.

These very favorable stress conditions in a circular subaqueous tunnel cannot be equaled by any other section, since in all non circular sections the uniform water pressure produces moments increasing with the depth of submergence. Therefore, for the precast portion of both tunnels, circular sections were selected, the octagonal section being also considered as equivalent to a circle. For the cast in place parts of the tunnels, circular sections also proved to be the most economical, and were used except for portions of the Elizabeth River Tunnel at relatively shallow depths, where a box section was adopted for other reasons.

Financing Influences Construction Program

The Baytown Tunnel was financed by the State of Texas, and speed of construction was not of great importance; in fact the construction time has had to be extended to give the state time to provide the necessary money. The Elizabeth River Tunnel, on the other hand, was financed by revenue bonds, and an early completion date was of particular importance in order to obtain revenue for payment of interest and amortization. As a result of these conditions, the construction sequences of the two tunnels were quite different.

At Baytown the precast portion of the tunnel was completed prior to construction of the cast in place tunnel, in order to simplify the connection of one type of structure to the other. All precast sections were installed in sequence, starting from one bank and proceeding to the opposite end, the successive sections being joined together under water as shown in Fig. 5. Then a dike was constructed at each bank, and the precast tunnel was connected with the adjacent cast in place structures in the dry. Slight discrepancies in the overall length of the precast portion of the tunnel were readily taken care of in the connection to the cast in place part.

At Elizabeth River, in order to expedite the work, all parts of the tunnel were constructed simultaneously. Installation of the precast sections commenced at the Berkley end. Here the construction of the cast in place tunnel was delayed and could not be completed prior to sinking of the adjacent precast section. Accordingly, this precast section was sunk first. A water retaining dike was built across the section, the dike being connected to the shore at each end, and the cast in place part was then built in a dry trench and connected to the precast section. Unwatering of the trench at this location was accomplished by well-points and two deep well pumps.

At the Portsmouth end, the cast in place tunnel was constructed in advance of the precast part. Here the connection between precast and cast in place tunnel was an underwater job. The precast sections were connected together in sequence from the Berkley to the Portsmouth end, and the last precast section at the latter end had to be moved into place horizontally in a submerged state so as to pass under the trench bracing, as previously mentioned. This required moving the last precast section into place before the second last section was installed.

The last section was supported from the booms of crawler cranes in such a manner that the supporting hitches could be successively disconnected and shifted under the bracing frames. The tunnel section was temporarily "parked" at a location about 18 in. shorewards from its final position. Then the next-to-last section was sunk into place and connected to the preceding one. Finally the last section was lifted clear of the bottom and, in a submerged state, was moved back sufficiently to permit connection at the outer end with the adjacent precast section, and at the shoreward end with the cast in place tunnel.

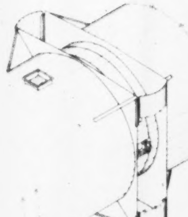


FIG. 5. At Baytown Tunnel, underwater connection between adjoining precast tunnel sections is made by means of steel flange with interlocking sheetpile knuckles, welded to sections before sinking. After sections are bolted together, steel plates are sprung into sheetpile joints, and entire joint is filled with tremie concrete. Minimum underwater work contributes to low cost. Same method was used on Elizabeth River Tunnel except for last precast section on Portsmouth side, shown in Fig. 6.

The connection method is shown in Fig. 6.

Problems of Geology and Soil Mechanics

The dead weight of the completed precast tunnel sections is only slightly higher than their buoyancy, both at Elizabeth River and at Baytown. This means that the weight of the tunnels resting on the underlying ground is smaller than that of the soil displaced. Hence the soil mechanics problems involved in the foundation design are primarily whether heaving of the foundation can take place, rather than settlement of strata beneath the tunnels.

For both tunnels, heaving of the soil under the precast portions was not expected. At Baytown, the underlying stratum was clay or sand which gave no indication of possible swelling after removal of load. At Elizabeth River, the substrata were generally sand, except close to the Berkley end of the precast section and throughout the cast-in-place section, where the tunnel rested on silt. For the precast tunnel, the original balance of weights on the silt could be restored by a reasonable specification for the depth of backfill over the tunnel and the unit weight of the material used for backfill.

The open approach at the Berkley side involved an intricate problem in soil mechanics. Where the original silt deposit reached the open ground surface, a compensation for the weight deficiency of the tunnel section could be achieved by increasing the weight of the tunnel section (using a box section), by backfilling over the tunnel with sand which was heavier than the original silt, or by slightly increasing the height of the backfill. But wherever the upper layer of natural soil above the silt was sand, a balance of loads could be obtained only by providing an excessive depth of backfill over the tunnel.

A laboratory analysis of the silt indicated that heaving of the soil to the amount of 4 in. might be expected under the cast-in-place structure. Heaving of this amount was considered dangerous to the watertightness of the tunnel, and it was decided to attempt to cause the heaving to take place prior to construction of the cast-in-place tunnel.

The "preheaving" of the silt could theoretically be achieved by dredging out the trench and leaving it empty for some time, the load on the silt under these conditions being even less than it would be after completion of the tunnel. This might be called "negative preloading," which was expected to heave the soil to the required height. However, the time necessary to achieve this, as estimated from the laboratory tests, proved to be too long for the construction schedule. Accordingly sand filters in the silt were proposed to speed up the negative preloading, by facilitating access of water to the interior of the silt stratum.

In view of the fact that silt in situ often behaves differently from laboratory samples, and also to test all arrangements for the negative preloading, it was decided to make a full-size negative preloading test for a portion of the open approach. For this purpose, sand drains of 18 in. diameter were spaced 14 ft on centers both ways. These were covered with a sand blanket to make sure that surface water could easily penetrate into the silt. According to theoretical computations, a 4-in. heave could be expected under this arrangement in 10 to 12 days. When after two weeks no measurable heave occurred, the drains were plugged with bentonite grout to restore the

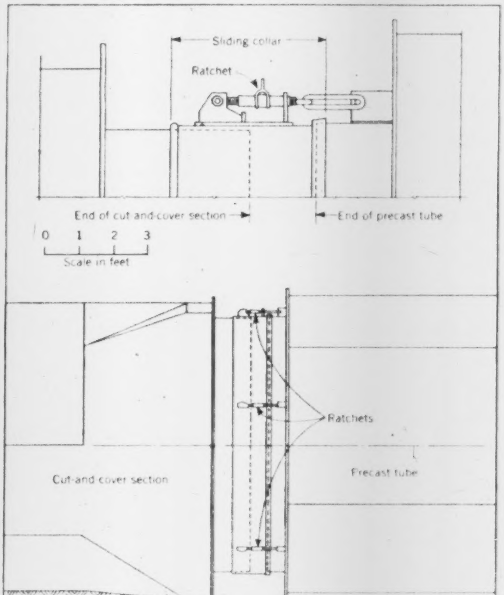
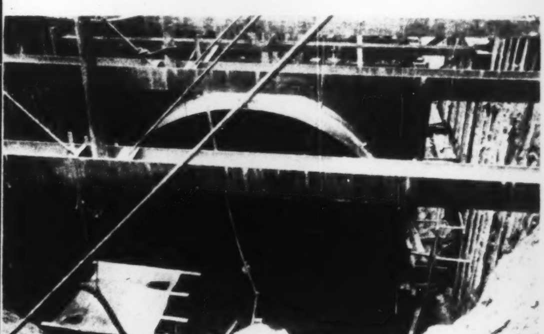


FIG. 6. Joint at shoreward end of last precast tunnel section at Portsmouth end of Elizabeth River Tunnel was formed by sliding sleeve on outside of section. At time of placing, sleeve was drawn back over tunnel section, later it was slid out to form connection.



East face of cast-in-place section on Portsmouth side of Elizabeth River Tunnel is seen from Sta. 27 + 00 with sliding sleeve extended. See Fig. 6.

original permeability conditions in the soil.

Two explanations were considered as to why the silt did not behave in the manner predicted from the laboratory tests:

1. The permeability of the silt in situ was many times larger than that measured in the laboratory samples.

2. The permeability in situ exceeded that determined in the laboratory, and in addition the ultimate compressibility of the silt in situ was much smaller than that indicated by the samples.

From the point of view of construction, the difference between these two explanations was important. If No. 1 were correct, it would mean that the silt swelled considerably during excavation of the trench, and would be apt to consolidate quickly under subsequent loading by the weight of the tunnel. If No. 2 were the explanation, no considerable movement at all could be expected.

It was easy to prove by field tests that the permeability of the silt in situ was 20 to 30 times larger than measured in the laboratory. Therefore the settlements under the load of the tunnel in any case could be expected to be practically instantaneous. Hence it was decided to build one section of the tunnel while constantly observing its settlement, and base future action on the results of these observations. It was found that settlements under the full load of a tunnel section did not exceed [illegible] in., and that no special measures were necessary to keep intact the alignment and watertightness of tunnel sections founded on silt.

The negative preloading test thus clarified the properties of the substrata and saved time and money by excluding for the full length of the cast-in-place structure any "improvements" of tunnel foundation.

Two Different Ventilation Methods

Ventilation for the Baytown Tunnel was provided by a forced supply, in which fresh air is blown into the tunnel through ducts. At Elizabeth River, the exhaust ventilation system was used, in which foul air is withdrawn by fans. Either system can be depended on to provide fresh air in a tunnel, even under the most critical traffic conditions, the choice depending on questions of economy and fire safety. Experience obtained during the 1948 fire in the Holland Tunnel indicated that the exhaust system is definitely safer in case of fire; therefore it was adopted at Elizabeth River in spite of slightly higher cost.

Before design of the Baytown Tunnel, the standard practice with precast tunnels was to locate the ventilation building directly over the tunnel, the tunnel section forming a structural unit with the building. This layout was used at Baytown, but it was found that such an arrangement results in a heavy building requiring a special foundation. Short intermediate tunnel sections must be provided between this structure and the adjacent portions of the tunnel to eliminate the detrimental effects of differential settlement.

At Elizabeth River it appeared that it would be advantageous from a property standpoint, and helpful to the construction schedule, to locate the ventilation building to one side of the tunnel in an independent structure. Thus the designer had an opportunity to produce a relatively light ventilation building, with air ducts and access passage connecting the building with the tunnel. To prevent differential settlements between the tunnel and the building, the latter was founded on piles reaching to the same depth as the tunnel. In addition, the connecting ducts were provided with elastic joints to insure their watertightness even under differential settlements. (See Fig. 7.)

The section of tunnel to which the ducts connected was designed especially to receive them, but its foundation was the same as for the adjacent parts of the tunnel, thus eliminating the danger of differential settlements in the tunnel proper. The foundation of the ducts and of the ventilation building presented certain problems which were successfully resolved. The economy resulting from the final design indicates that the possibility of separating the foundations of tunnel and ventilation building should be considered in future designs.

The Baytown and Elizabeth River tunnels were designed by Parsons, Brinckerhoff, Hall & Macdonald, consulting engineers. J. O. Bickel, M.ASCE, and T. O. Blaschke, A.M. ASCE, were in charge of general design; the writers, H. Alden Foster and S. Steuerman, conducted special studies of structural design; S. R. Apt supervised the design of the ventilation systems; and the late Soren A. Thoresen, M. ASCE, served as consultant.

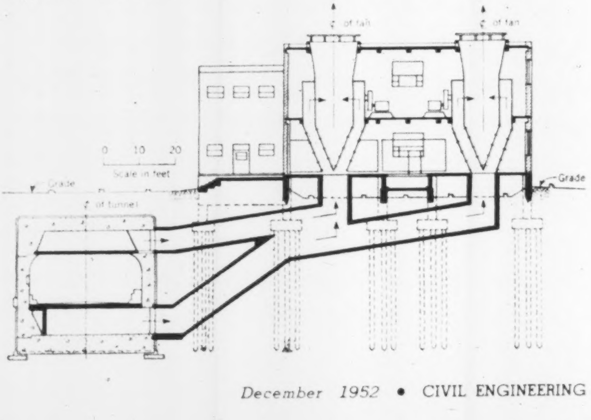
At Baytown, William H. Bruce, A.M. ASCE, was resident engineer for the consulting engineers. The contractor for the subaqueous part of the tunnel was Brown & Root, Inc., of Houston, Tex. At Elizabeth River, George J. Murphy was resident engineer; and Merritt-Chapman & Scott Corp. and Tidewater Construction Corp. were the contractors.

Soil mechanics tests and investigations for the Elizabeth River Tunnel were made by Prof. Edward S. Barber, A.M. ASCE, of the University of Maryland.

Construction of the Baytown Tunnel commenced in August 1949. The subaqueous portion was "holed through" in November 1951. Completion of this tunnel is scheduled for the spring of 1953.

Construction of the Elizabeth River Tunnel commenced in March 1950. The tube was "holed through" in December 1951, and the tunnel was completed and placed in operation on May 23, 1952.

FIG. 7. Section through Elizabeth River Tunnel and ventilation building shows method of supporting light building on piles entirely independent of tunnel, thus avoiding danger of differential settlement. Elastic joints in connecting ducts ensure watertightness if settlement occurs.



The status of atomic power

B. R. PRENTICE, Manager, Schenectady Office, Nucleonics Division, General Electric Co., Schenectady, N.Y.

The author here summarizes in a remarkably clear manner just what is the present gap, technological and economic, between the production of fissionable material for weapons and the generation of electric power from atomic fuel, on such a basis as to make it competitive with conventional hydrocarbon fuels. Because of the significance of the subject and the wide interest in the commercial possibilities of producing electric power from atomic fission, Mr. Prentice's paper is here printed in its entirety. It was presented during the Centennial of Engineering Convocation, before the Power Division of the Society, presided over by Chairman Byron McCoy of the Division's Executive Committee.

The remarks in this article will be in the general area of atomic power for the generation of commercial electricity. That, of course, is in a field which is not yet an industry in being. But it is one which is closely related to an industry in being—the production of material for atomic weapons. I will also comment on some of the atomic power developments for other purposes, such as ship and aircraft propulsion, because they bear a very close relationship to the future of commercial electricity from atomic power.

There are two technical facts we need to keep in mind which are peculiar to power from atomic energy. One is the fact that in an atomic plant producing electricity it is also possible to produce atomic fuel. As you doubtless are aware, plutonium is an artificial element produced from uranium in a nuclear reactor. It is presently being produced for atomic weapons. Being a "fissionable material," it is as good a material for atomic fuel as it is for weapons. It is presently being produced at Richland, Wash., where the General Electric Co. operates the Hanford Works plutonium production plant for the Atomic Energy Commission.

The Hanford reactors do two things—they make plutonium and release energy. For sound reasons the energy is not converted into electricity. Nevertheless, these reactors do involve one particular solution of the many problems associated with the simultaneous production of atomic fuel and the release and transfer out from the reactors of vast quantities of heat. You will find that these two processes are so basically interlinked and interdependent that they must be considered together.

How New Fuel Is Produced

We need to go one step further with this first fact and mention the quantity of new fuel produced. Some atomic fuel is consumed as energy is released. Some new fuel is manufactured. The ratio of fuel manufactured to fuel consumed is important. This ratio is less than one in the Hanford reactors. But in certain kinds of reactors it can be greater than one. A reactor which produces more fuel than it consumes is called a "breeder."

This is neither perpetual motion nor magic. Uranium, as mined, contains two isotopes. The predominant isotope, with mass number 238, is not readily fissionable. The fissionable isotope with mass 235 is present in only one part in 140. An atom of U235 fissions when its nucleus accepts a neutron. Then as the fission takes place, several neutrons (about $2\frac{1}{2}$ on the average) are released. In a constant-rate reaction such as in an atomic power plant, as distinct from an accelerating reaction such as in a bomb, the number of fissions per second is constant.

The number of neutrons absorbed per second, causing fissions, is constant and equal to one neutron for each fission. But with $2\frac{1}{2}$ released by each fission, there is an excess of $1\frac{1}{2}$ neutrons per fission which are not needed for the release of energy. These extra neutrons are the most precious particles of matter in existence. While they cannot be sold as such, their value can be realized by using them to make plutonium. When a U238 nucleus accepts a neutron, it does not fission. It changes through some steps into plutonium. So the fact that there are available $1\frac{1}{2}$ opportunities to make plutonium atoms for each atom fissioned makes "breeding" possible.

The basic fact we have been examining is that new fuel can be produced simultaneously with the release of energy, and the term "breeding" is primarily a matter of degree. The reason this fact is so important in the economics of atomic power is that it has a major effect on both the going cost of fuel and the eventual amount of fuel available from nature's resources of uranium and thorium. If no new fuel were produced, the cost of uranium, in which only one part in 140 releases energy, would itself defeat atomic energy in competition with conventional fuels. If slightly less than one atom of plutonium is created for each atom fissioned, the new fuel can be recycled in a regenerative cycle and increase the energy yield per ton of uranium mined by ten to twenty times. If the ratio is more than one, as in breeding, the energy yield can approach 140 times that originally present, and a practical figure of 100 is not impossible. Obviously, fuel resources depend directly on the multiplication of fissionable material achieved. Fuel costs are affected, but costs depend also on the additional investment and operating cost of equipment necessary to process and recycle the newly created fuel.

Available Only as Heat Energy

The second basic fact we need to keep in mind is that atomic energy becomes available for our large-scale use only as heat energy. This fact determines much of the configuration of an atomic power plant. It means that many of the kinds of equipment of a conventionally fueled electric generating plant will be present in the atomic power plant. We will be dealing with the heat energy available in a nuclear reactor, picking up that energy in a fluid, transporting the fluid, and finally, transferring the heat to a thermodynamic fluid, probably steam, suitable for converting the heat to mechanical and then to electrical energy through a steam turbine-driven electric generator. High temperature, to get high thermal efficiency, will be important. The size, cost, and efficiency of all components will be important and will be governed by the same principles that apply to a normal thermal plant. In short, the atomic reactor and associated equipment can be thought of as replacing the fuel and boiler equipment in an otherwise conventional generating plant.

The broad nature of an atomic power plant can then be pictured as one in which everything from the turbine throttle on—the steam turbine generator, the electric generator, and the switchgear—would be essentially standard. The heat producing equipment from the turbine throttle back would be replaced by heat exchangers and by a nuclear reactor. Coal bunkers and pulverizers would be replaced functionally by equipment for fabricating fuel elements of uranium, plutonium, and mixtures of them. Very likely this nuclear reactor will also have connected with it facilities for which a conventional plant has no functional counterpart. These facilities are chemical separations equipment for processing the new fuel, plutonium. In order to be able to transport and ship plutonium, if it is to be sold, it would be necessary to separate from it the very radioactive fuel elements which come out of the reactor. A chemical separations plant may cost in the order of 20 to 40 million dollars.

Finally, a conventional plant has ashes to dispose of. So does an atomic plant, but atomic ashes—fission products—are intensively radioactive and remain so almost forever, so that the waste disposal function is different. The fact that so many functions are the same must not, however, mislead us to the conclusion that equipment to perform the functions in an atomic plant will cost the same to build or to operate. In fact, the differences in these costs are one of the main topics I will discuss.

Two Types of Customers

In considering the economic feasibility of atomic power plants, it is desirable to divide them into two groups. One group may be called single purpose plants, the other dual purpose plants. In this article a single purpose plant is defined as one that sells products only to commercial customers, not the government. The primary product, responsible for the majority of income, would be electricity. If fissionable material were sold, it would be to commercial customers, presumably to other atomic power ventures, as a fuel, at a price established by civilian supply and demand.

Dual purpose plants would serve two markets, the commercial market for electric energy and the military market for bomb material. The characteristics of these two groups of plants, of course, may overlap in a great many ways in technical detail. The reason for distinguishing between them is primarily my belief that no one can conceive today of a single purpose atomic power plant economically capable of supporting itself solely by the sale to commercial markets of electricity plus fissionable material. Of course no commercial market for plutonium exists yet. However, it is expected that the commercial price of plutonium will be much lower than present costs for military weapons. So talk about single purpose plants is necessarily limited to things that can be predicted without a clear definition of the plant equipment, its cost, its efficiency, and its operating problems and expense.

On the other hand, there does exist now a very substantial military market for plutonium. The present value of military plutonium is known. Many different configurations of dual purpose plants which are technically feasible can be defined in considerable detail. So it is not entirely out of the question at this time to consider a dual purpose atomic power plant marketing electricity in normal channels and selling plutonium to the government.

Cost of Competitive Atomic Plant

To demonstrate what I mean by the statement that it is not possible at this time to define the configuration of an economical single purpose plant, I would like to refer to some bogeys set forth by Walker Cisler, President of the Detroit Edison Co., in a talk he gave in June at the Michigan Law School Symposium on Atomic Energy. Mr. Cisler's bogey relates to permissible capital investment. He took the new St. Clare Plant of the Detroit Edison Co., a 625,000-kw steam plant costing just under 100 million dollars, as a yardstick.

He pointed out that the total investment in that plant was $158 per kilowatt of capacity. Of this total investment, $81 per kw is associated with the steam turbine and the electric generating equipment, which would not change substantially in an atomic power plant. The remaining $77 per kw is associated with the fuel handling equipment, boiler, and those parts of the plant which would be replaced by an atomic reactor. So $77 per kw would be the permissible investment in atomic equipment if fuel and operating costs were equal to those of a steam plant.

Atomic equipment is much higher in first cost, but it is hoped that the fuel cost will be extremely low. If so, how much more can the atomic equipment cost? To establish the extreme outside limit of investment, Mr. Cisler calculated that limit by assuming fuel and operating costs to be zero. All fuel and operating costs of the St. Clare Plant, capitalized at 10 percent, were equivalent to an additional investment of $150 per kw. This, added to the $77 per kw, gave $227 per kw as the extreme outside limit of investment in atomic equipment to produce steam at the turbine throttle. So, he observed, the bogey is somewhere between $77 and $227 per kw, depending on the fuel and operating costs of the atomic power plant.

Related to total plant cost, including electrical equipment, this gives a range between $158 and $308 per kw. Keep in mind that the figure of $308 per kw is a top limit calculated by assuming no fuel or operating costs whatsoever in the reactor part of the plant.

Now our studies of several atomic power plants, closely enough related to constructed plants or to developments nearing fruition to be considered feasible, show investments all falling above the range. Investments per unit of electrical capacity fall between $300 and $550 per kw. Clearly, a single purpose plant is, by that comparison, out of the question at this stage of technical development. Its investment is not even within the range established by assuming zero fuel and operating costs for the atomic part of the plant.

The foregoing comparison is valid only for a single purpose plant. The idea of setting a maximum limit on the investment by assuming zero fuel and operating costs is not as unreasonable as it might appear. A single purpose plant may well have income from the sale of plutonium sufficient to offset a major share of its fuel and operating costs.

A dual-purpose plant, selling plutonium at military market prices, may well get one-half to three-quarters of its income from the sale of plutonium and only half to one-quarter from the sale of electric power.

In that case an investment of $500 to $550 per kw is not necessarily unattractive purely because it is large. Such a plant may be looked on more as a plant primarily to produce plutonium for weapons, with electric power as a by-product, rather than the reverse. In that case, the investment comparison should be made with plutonium production facilities being constructed by the government rather than with an electric generating plant. Such comparisons are not unfavorable.

So we would like to be able to answer the $64 question, "Can a dual-purpose plant be made economically feasible?" I think there is not much doubt but that it can. The primary question is "Is it economically feasible?" and then, "Is a dual purpose atomic plant likely to become a reality, say in the next ten years?" The biggest "if" relates to the military market for plutonium. "At what rate will the government need to add to its growing stock pile and what can it afford to pay for plutonium, say 10 years from now and then 15 years from now, then 20 or 30 years from now?"

We have said that such a plant cannot support itself solely by the sale of electricity. It then depends on a military market. It is obviously very difficult for either a utility company or a manufacturer such as General Electric, or in fact for the government itself, to assess what the size of the market and the price will be that far in advance. Can the government guarantee a price over a long period? If not, what can one reasonably expect, or risk, that the government will pay for plutonium? These are really quite imponderable questions.

There are other questions facing utility companies and others looking at the possibility of a dual-purpose atomic power plant. Some are legal questions. Can a utility company own such a power plant? Of course, it cannot under the present law. There would be major technical decisions required in the selection of reactor type, coolant, and many others that I do not expect to explore here. However, most engineers who have looked at such problems feel confident that the technical problems can be solved. It is primarily a question of economics, but because some of the criteria are so uncertain, as previously outlined, I cannot give a direct answer to this $64 question. Perhaps we ought to call it a $200,000,000 to $300,000,000 question, because that is the kind of money that would have to be invested in an atomic power plant to make it actually competitive today with plutonium manufactured in modern government plants.

AEC Plutonium Plants Provide Knowledge

I would like to give you, as well as I can, some picture of the status of the various programs of the Atomic Energy Commission as they relate to the future of atomic power plants and also to discuss the competition a dual-purpose plant must meet. To do that, I will divide the various atomic energy programs into five categories:

1. The AEC's plutonium production plants
2. The Navy's and AEC's atomic submarine and ship-propulsion developments
3. AEC's experimental reactor program
4. AEC sponsored design studies
5. Economic and feasibility studies by four industry-utility groups

All the plutonium produced now comes from the Hanford Works at Richland, Wash., operated by General Electric Co. Plutonium is produced in graphite moderated, natural uranium-fueled, water-cooled reactors. Plutonium is separated from uranium in chemical separation plants and prepared in a form suitable for delivery to the Government. That program is a very major one. Production was started by Dupont in late 1944. The General Electric Co. took over operation in 1946 and has been operating the works since then. The plant capacity has been materially expanded. Reactors and processes have been greatly improved, and the cost of plutonium is being reduced each year by substantial amounts. Another phase of the plutonium production program is a plant under construction by Dupont at Savannah River. Heavy water-moderated reactors will be combined with separations plants to perform the same functions provided at Hanford, and that program can also be used to produce materials for so-called "hydrogen bombs."

Is Heat Being Wasted?

A good many people, when they realize the tremendous amount of heat energy which comes out of the Hanford reactors and is discharged to the Columbia River, feel a sort of engineering guilt. They say that heat is being "wasted" and wonder why it is not converted to electric power. Really there is a tremendously sound reason why the heat is rejected and not used. It is possible, even today, to construct new production facilities without power several years earlier, and with a lower investment, than if time were taken to develop a high temperature reactor for producing both plutonium and power. Therefore, even in the Commission's present expansion program, the reactors which will be constructed will not produce electric power. It is obviously in the nation's interest to produce plutonium as promptly and as cheaply as possible. Plutonium capacity can be constructed now, for less money and several years sooner, by discharging the heat to the Columbia River.

In my opinion, many commentators setting out to assess the status of atomic power make a substantial error by basing their estimate of progress only on those few projects whose sole objective is commercial atomic power. Such a narrow view fails to count in the applicable knowledge and experience gained in work toward different objectives. The plutonium production plants are a prime example of a wealth of applicable experience and know-how gained at full scale, with continuous and extensive operating experience. And the value of this is overlooked just because these plants produce no power. But as we have seen, the production of plutonium is expected to be as important to an atomic power plant as is the power itself.

At Hanford a multitude of applicable problems are being solved. Large-scale reactors are operated day in and day out. The vast quantities of heat, more in one reactor than in the largest steam boilers, are removed and temperatures are rigidly controlled. Loading with fuel and unloading radioactive spent fuel is accomplished. Repairs and capacity-increasing modifications are accomplished on reactors in place. High load factors (the plutonium produced each month is directly proportional) are achieved, and many of the problems solved to provide high availability point the way towards methods of obtaining reliability in atomic power plants. Safety of employees from radiation injury, either from the reactor or from the radioactive spent fuel elements which they handle and process, has been demonstrated to be possible to an almost unbelievable degree of perfection. From 1944 to date, not one employee at Hanford has received a radiation injury.

Reactor problems, however, are not the only applicable know-how gained in these production plants. Remember that plutonium production is one of the "dual purposes." Discharged fuel containing plutonium, uranium, and intensively radioactive fission products is processed through remote-controlled chemical separation plants. The functions performed may each be essential in the atomic power plant of the future. Uranium and plutonium chemical and metallurgical processes are accomplished on a production basis. Radioactive wastes are processed, stored, and monitored. The process development, design, construction, operation, and repair and modification of remotely controlled chemical and metallurgical processes are accomplished on a production basis.

Not only does the experience at Hanford, and more to come at Savannah River, provide a vast amount of proven knowledge applicable to atomic power plants; but the basic fact that large-scale reactors, chemical separations and waste storage have actually been accomplished as a regular manufacturing operation provides a foundation from which we could embark on a major atomic power venture with a sure-footedness hardly possible if all the background were on a laboratory or pilot plant scale. The importance of these matters to atomic power is too often disregarded.

Power for Ship Propulsion

Now to discuss the second group of projects. The Navy has a very immediate incentive for wanting to use atomic power for the propulsion of naval ships, particularly submarines. This incentive comes from the fact that fissionable material is such a tremendously concentrated source of energy. Compared to coal, it has about three million times the concentration of energy, pound for pound. Therefore a nuclear reactor can provide a submarine with almost unlimited range without refueling compared to a conventionally fueled submarine. There are certain other advantages. No air is needed for combustion. Therefore such a submarine could operate submerged for long periods and at high speed.

For these reasons the Navy has a very intensive development program which is being implemented in two channels. One line of development is progressing at the Knolls Atomic Power Laboratory, operated by General Electric at Schenectady, N.Y. This is what is called the Submarine Intermediate Reactor (SIR). "Intermediate" is used to describe intermediate speed neutrons. This reactor operates at relatively high temperature, and heat is transferred by liquid sodium. The other Navy development channel is called the Submarine Thermal Reactor (STR), being developed by the Westinghouse Co. in cooperation with the Argonne National Laboratory. This reactor is being constructed at Arco, Idaho. The word thermal designates the use of slow neutrons, or thermal neutrons. This reactor is water cooled.

Other recent naval reactor developments of larger power are also being implemented. These two major development channels are second only to the plutonium production program in the amount of money and technical effort that are being expended per reactor project. While these reactors do not produce fissionable material, they do release energy at high temperature, and this energy is converted to electricity. A great many of the technical problems of getting this heat energy out of a reactor at a useful temperature and into steam turbines are being solved in those two channels of development. Compact reactors, fueled with quite concentrated fissionable material, designed for high thermal efficiency, high reliability, and for fast but simplified control, are being reduced to practice at significant power levels. Such developments require a vast amount of pioneering research and investigation, the results of which will be available for commercial atomic power. For example, a multitude of new materials problems, peculiar to high temperature nuclear reactors, have been investigated. Problems of pumps, valves, shielding, loading, and unloading of fuel all involve new additions to the art. The contribution of these development programs to the future of atomic power will be of very great magnitude.

In the two Commission programs, plutonium production and naval ship propulsion just discussed, it is significant to note that each is contributing in a major area to the future of commercial atomic power plants. Yet the end use of each program is in itself sufficient justification for major expenditures in research, development, construction, and full-scale operation. This is indeed fortunate for the electric utility industry, inasmuch as a realistic conception of a truly self-supporting single-purpose plant is still in the future.

Experimental Reactors Under Study

The third group is the AEC's experimental reactor program. Quite a number of reactors are involved but I will limit myself here to comments on only a few. One is the experimental breeder reactor which has been developed by the Argonne National Laboratory here in Chicago. That reactor is now running at Arco, Idaho. It went critical last fall, and by December was generating sufficient electricity to carry its own auxiliaries with some power to spare. Heat is removed by a liquid metal, sodium-potassium alloy, at fairly high temperatures, from which steam is produced and electricity generated. While the power rating is small, this reactor does demonstrate the ability to convert atomic energy to electricity, and its primary purpose—technical data relating to the breeding process—is of value to the future of atomic power.

The homogeneous reactor experiments at Oak Ridge appear important to the future of atomic power. This is at present a small-scale reactor experiment. Its very novel approach involves fuel in fluid form, that has certain very attractive features bearing on the low-cost processing of fuel. This work, or offshoots from it, may have a major effect on future atomic power plants.

Another experimental program which is developing technology beneficial to the future of atomic power is the aircraft reactor program. Two channels are being explored, one by General Electric at Lockland, Ohio, another by Pratt and Whitney. The objective is to develop nuclear reactors and associated propulsion equipment to propel a test airplane. These two projects will involve a major expenditure of technical effort, and they will without question contribute to the technology benefiting the future of commercial atomic reactors.

Design Studies

Experimental and production programs which are implemented on a substantial scale are always preceded by design studies, the fourth category to be discussed. Obviously, many more design studies are made than are implemented. Implementation generally depends on whether the project meets a particular and immediate need. Even though they are not implemented now, many studies are of value in looking toward the future. Also, some serve the purpose of ruling out undesirable avenues and focusing attention on profitable channels of development.

The fifth category, to which I wish to devote quite a bit of time, is the four studies made by utility-industry groups. Somewhat over a year ago, the Monsanto Chemical Co. proposed that it might be time to consider whether or not a dual-purpose plant could support itself through the military market for plutonium. Monsanto joined with Union Electric of St. Louis to study the economics and feasibility of such a plant. Three other groups of companies also undertook such studies. The Detroit Edison Co. associated with the Dow Chemical Co.; Commonwealth Edison, Chicago, associated with a subsidiary, the Public Service of Northern Illinois; and Pacific Gas & Electric of San Francisco associated with the Bechtel Corp.

These four groups have completed the first phase of their studies. While the Commission has not yet announced the conclusions, the public announcements of some of the companies have made a few things seem clear. One is that none of the companies have yet decided that it is desirable to undertake immediate full-scale design and construction, and private financing of a dual-purpose plant. On the other hand, they have all indicated that they are sufficiently interested in the future of atomic power to continue their studies, and two of the companies have indicated that they wish to undertake expanded privately financed experimental programs. This is a very interesting development.

As an equipment manufacturer the General Electric Co. is potentially interested in the manufacture of equipment for atomic power plants, and welcomes very much the opportunity of association in future planning with plant operators and customers. Until these studies were undertaken, there were no utility operators involved in major atomic energy projects. Neither were there any who had staffs studying the technology of atomic power. Now there are at least four operating utilities who have cleared personnel and who have spent a year getting the background in this particular field. It will, of course, be necessary, as it is in any industry, for user and manufacturer to agree on what to build.

A big link in the necessary chain of events is being forged which will lead ultimately to private-utility owned and operated atomic power plants. I think no one should construe the fact that these groups are not immediately setting out to build power plants as at all discouraging. In fact, their continued interest in the field is quite encouraging, certainly for the long-range future of atomic power plants if not for immediate dual-purpose plants built to take advantage of the transient military market.

What Is the Competition?

To summarize, the following are the competitive values that a dual-purpose plant would apparently have to meet. On one hand, such a plant would sell electric power, and it would have to compete with conventional fueled steam plants which are of the most modern design, with high thermal efficiencies. Such competition also includes plants which gain economy through their very large size. According to a recent announcement, there is under contract a plant to develop about 1,400,000 kw to serve the Ohio atomic project. Such modern, efficient, large and reliable plants form the base against which a new atomic energy plant has to compete. On the other hand, as a plutonium producer, a dual-purpose atomic power plant also is faced with competition by very major plants. The plant at Hanford, when the present expansion is completed, will cost over a billion dollars. This plant includes very large nuclear reactors, plus new and efficient chemical separation processes. The plant is continually being modernized to reduce the cost of its product.

Thus a new atomic dual-purpose plant will be faced with competition from two industries in being. This places very different values on the degree of technical development required of such a new plant from those required for competing with plants of the same general infancy as itself. As just one example, since size effects economy, a dual-purpose plant would probably have to be of the same order of magnitude as the power and plutonium plants with which it must compete. Obviously, this is a serious deterrent to a utility company considering investing in such a project.

In fact, our studies of plants which could be designed and constructed, say within the next ten years, indicate that investments of the order of $200 to $300 million would be necessary to build a plant large enough to be competitive with expected power and plutonium values. While I believe that such a dual-purpose plant is technically feasible, it is not yet clear whether it is either desirable or economically justifiable in the immediate future. Furthermore, the bomb stock pile grows daily. Production capacity is being expanded which will increase the rate at which the pile grows. Bombs do not deteriorate. Therefore the time for a dual-purpose plant to tap the military market is running out.

Now how about single-purpose plants? In my opinion, there is a long-range incentive which I feel will impel the development of single-purpose atomic power plants in the future. It will be due to the inevitably increasing cost and decreasing reserves of conventional fuels. To put one's finger on the exact time when that is going to supply a strong motive and competitive advantage to atomic power is an extremely difficult job.

Uranium and Coal Reserves

The Commission has asked a qualified engineer, Mr. Palmer Putnam, to examine the world and U. S. resources of uranium and compare them, energy unit for energy unit, with the resources of coal. He came to a number of very interesting conclusions. One of them is that the world's uranium reserves are some 10 to 20 times the energy content of its economically minable coal reserves. The basis for this figure requires some explanation. He assumed apparently that breeding would be sufficiently successful to burn up U238, the plentiful part of uranium, not just rare U235, and therefore, this figure of uranium reserves is predicated upon the success of certain kinds of nuclear reactors. But that is an adequate assumption for his purpose.

Ten to 20 times the coal reserves is a tremendous quantity of energy. One might expect that coal will increase in price relative to labor and other factors as lower-grade deposits have to be used. On the other hand, the program for the production of plutonium and the program of the development of mobile reactors for naval craft and aircraft is bound to materially advance the technology of reactors, of separations, and of nuclear fuel.

Each year and each decade these advancements in related channels will permit the conception of a single-purpose atomic power plant with lower cost. Sooner or later it will become economically attractive. Then you will see atomic power plants. But their growth and their effect on conventional fuel industries cannot be other than gradual. Atomic power cannot suddenly displace or replace power from any conventional fuel.

In conclusion, I feel it is very important not to look merely at the few projects whose sole objective is commercial atomic power and conclude that very little is being done in this field. One of the things I have tried to show is that the major atomic programs, which are implemented to fill certain other needs, such as the need

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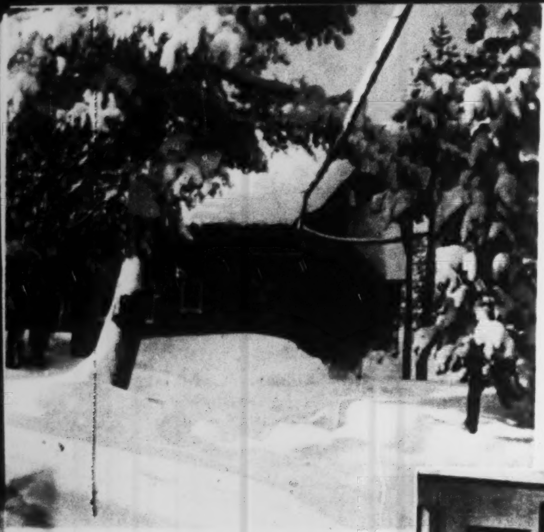

Snow thermodynamics

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Central Sierra Snow Laboratory is located at El 6900, near Donner Summit, Calif. Research area covers 4 sq miles of mountain terrain. Above, snow is 10 ft deep, hiding entire first floor. At right, strip charts on instrument panel laboratory record data on most meteorological factors discussed in article.

In states west of the hundredth meridian the stored water in a winter's snow pack in the high mountains is worth more, agriculturally and industrially, than all the gold and the other less precious metals mined. Since the deeper snow packs are confined to high elevations, usually above 4,000 ft, they impose only a limited handicap on transportation and little or no handicap on ordinary engineering construction or industrial operations.

Eastward and north of the thirty-eighth parallel, winter snowstorms, frequently accompanied by blizzards, delay traffic, retard operations of all sorts, and may cause greater financial loss to the population of large areas than any benefits derived from the water supply contributed by the storm.

Contrary to the usual concept, the volume of seasonal snow creates neither a physical impediment nor an engineering problem in most of the arctic, although it may cause difficulties by drifting. More than two-thirds of the arctic may be classified climatologically as desert. Fort Churchill on the southern edge has a total precipitation of 10 in. a year, about one fourth that of Minneapolis. The area around Eureka at 80 deg north latitude, with only 1.6 in. of precipitation in a year, is comparable to the Mojave Desert of California.

Snow Is Unstable

The water in a falling raindrop and that which is stored in liquid form in all fresh water lakes, rivers, and reservoirs has the same physical and mechanical properties. A few well-established hydrodynamic and hydraulic constants define construction and design limits.

On the other hand, snow is an unstable material, highly variable in its physical and mechanical properties. Its density may range from less than 0.05 to more than 0.65. Its shear strength may vary 35 percent or more, fluctuating around a value of 7 psi at 0.40 density. Fabric collapse may be influenced by surface cohesion between crystals, by the presence of ice fusion bonds between the crystals, and by crystal size.

Snow has the properties of hydrodynamic fluidity and of plastic deformability. Forces within a certain limit produce a displacement similar to plastic deformation. Forces beyond a certain critical limit cause snow to behave like a fluid.

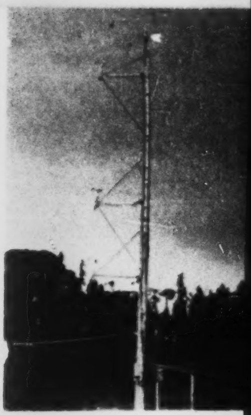
New fallen snow may be as difficult to handle as a pile of feathers. The handling of very old snow with an end-of-the-season density of 0.55 or greater may require heavy excavation or quarry techniques. New fallen snow, the school child's delight, with its beautiful and complicated crystal forms, is unstable and rapidly breaks down into simple fine-grained saltlike crystals. Then, with subsequent settling, the structure of the snow pack becomes very similar to that of a slightly damp heap of salt.

Diurnal and long term temperature cycles appear to be the major source of energy for further crystal growth and the fusion process in the snow pack which, at low temperatures, results in a fabric structure similar to that of a cinder block. Layers of high-density, strongly fused snow crystals, which have mechanical properties approaching those of ice, may be stratified as continuous planes or as discontinuous lenses within a low-density snow pack. The gross mechanical properties of this complicated structure are difficult to evaluate but must be considered in the design of equipment such as snowplows, tractor tracks, and grousers. The effect of the arch action within laminated profiles on the distribution of the load warrants recognition in engineering design. Metamorphic processes which take place within the deposited snow during a storm may have a marked influence on the weight distribution of the snow load resulting from that storm.

Bearing Capacity Variable

From the military standpoint, snow creates logistic and strategic problems regardless of where it falls, how much accumulates, or how long it may lie on the ground. As an example of a simple logistic problem, new snow may support less than 0.1

offers better understanding of mechanical properties of snow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psi, and if deep enough will immobilize not only foot troops but also the most powerful tractors or displacement plows. Within a day or two, natural thermodynamic processes which are little understood or poorly defined produce a bearing capacity of 0.7 psi, capable of supporting snow tractors of light weight and special design, such as the M-7 or the commercial Tucker.

Under favorable meteorological conditions, a bearing capacity of 2.0 psi may be achieved within less than a week. Then a heavy track-type over-snow vehicle can be supported with a minimum compression or non-impeding displacement of the snow. If such a tractor is used to transport supplies on sled-type trailers, the problem is further complicated by the enormous variation in friction between the runners and the snow. The coefficient of sliding friction for snow varies between 0.012 and 0.428, and the coefficient for static friction, between 0.1 and 1.0, depending on temperature, the surface structure, and other undetermined properties.

Results of Early Research

Researchers on snow in Japan, Switzerland, and Russia have reported that its physical and mechanical properties on the ground are determined largely by the integral effect of the preceding temperatures and other meteorological elements. Changes in the fabric of the snow pack due to crystal growth apparently are the products of an unstable environment. In Switzerland snow has been preserved at a low fixed temperature in the laboratory for weeks without a change in the crystal form. However, when snow was subjected to an artificial temperature gradient in the laboratory, crystallographic changes like those occurring under natural conditions were obtained. Although the thermodynamicist recognizes that sublimation, fusion, and vaporization

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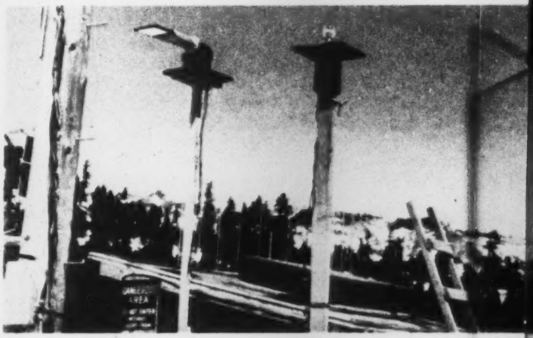

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Equipment used in modern snow thermodynamics is pictured here:

(1) Micro-meteorological mast, one of four in the area, is used for collection of data on wind velocity and direction, air temperature, and humidity. Hubbard-type truss arm on pole supports part of radioactive snow gage which measures water equivalent of snow in ground by attenuation of gamma rays from Cobalt 60.

(2) Eppley pyrheliometer on right provides record of total solar and sky radiation received at snow surface during day. Gier-Dunkle radiometer on left measures both solar and long-wave radiation. Both instruments give data which assist in determining net exchange of radiant heat between sky and snow by day and by night.

(3) Portable anemometer and shielded resistance thermometer for measurement of meteorological elements near snow surface are shown in foreground. In background are Eppley pyrheliometer and Gier-Dunkle radiometer.

(4) M-7 snow tractor stops at radio-telemetering snow gage. Gage measures, in terms of attenuation of gamma radiation from Cobalt 60, water equivalent of snow on ground and transmits information, through a relay station, to central headquarters.

take place isothermally, isobarically, and reversibly, the extent of the morphological processes in the snow under such conditions has not been demonstrated.

A review of many translations from foreign literature indicates that even at low temperatures a quasi-crystalline liquidlike film may exist on the surface of a snow crystal and that at low temperatures bound water and supercooled water may coexist with the solid and vapor phase. The inherent molecular instability of the individual snow crystals is also reported as a source of energy by which the metamorphic processes may be explained.

A search of the limited technical literature on the subject indicates that an unstable external environment and the associated phase instability within the snow pack may be the major sources of potential energy for the production of changes in the physical structure and mechanical properties of snow.

Because much of the past research on snow and ice was conducted in Russia, Japan, Switzerland, and Germany, the published results are not too readily available. In many cases, translations have been found to be unreliable or non-verifiable.

Thermodynamic Studies at SIPRE

Because of the inadequacy of available information on the physical and mechanical properties of snow, on the thermodynamic processes which effect these properties, and on the meteorological elements which are the source of energy for the metamorphism of the single crystals and of the snow pack structure, the Snow, Ice and Permafrost Research Establishment (SIPRE) is undertaking an intensive research program.

Major emphasis has been placed on a comprehensive study of the micro-meteorological elements in the 50-ft layer of air above a deep persistent winter snow pack in the high Sierra. SIPRE has assumed major responsibility for conducting the project at the Central Sierra Snow Laboratory near Donner Summit, Calif. This laboratory has been operated cooperatively by the Corps of Engineers and the U. S. Weather Bureau since 1945 as a snow hydrology research station.

The five-year record of hydrometeorological data, and the very good field and laboratory facilities available in an area of heavy and frequent winter snowstorms, make this station particularly well adapted to its purpose. Proximity to U.S. Route 40, an all-weather highway across the Sierra, and to the hotel and shopping facilities of a prominent ski resort area, further enhance the value of this station, particularly from the standpoint of personnel morale.

At the laboratory, wind travel, air temperature, and dew point are being sampled and recorded at fixed elevations of 20, 30, and 50 ft above the ground surface and, by means of adjustable instruments, at several other elevations between 1 and 15 ft above the snow surface. The instruments are mounted on four 50-ft masts so erected that the desired elements are being sampled at an open meadow site, at a thinly wooded site, and at two intermediate sites. Temperatures at several depths under the snow and in the soil are obtained from permanently installed resistance thermometers or thermocouples. Thermocouple probes in test holes provide supplemental data as required.

Wind direction and incoming long-wave and solar radiation are measured continuously at the mast at the open site. Here also are measured both the amount of solar radiation reflected by the snow and the amount of long-wave radiation absorbed by the snow or lost to the sky and surrounding objects. The measurement of these elements provides the data which are being used to evaluate the net heat exchange between the snow and its environment, and thereby a measurement of the major source of energy for the thermodynamic processes which produce the changing physical and mechanical properties.

Snowfall duration and intensity are measured in equivalent inches of water in a large-capacity recording Stevens "Q" precipitation gage equipped with an oversize reservoir in which a charge of calcium chloride is used to melt the snow as it falls. A snow stake and a standard hydrologic-type snow survey course provide additional information on the depth and density of both storm and residual precipitation.

A radioactive snow gage developed by the Corps of Engineers and the U. S. Weather Bureau provides daily or more frequent information on the accretion and depletion of the water equivalent of the snow pack on the ground at the research site, without disturbing the snow. Such non-destructive sampling is highly important but difficult to achieve in this type of research. Under contract to the Corps of Engineers, Motorola, Inc., has developed pilot commercial models of the radioactive radio-telemetering snow gage.

To determine the influence of the measured elements on the metamorphic processes in the snow, each storm layer is identified with colored cellophane or string. Pits are dug at selected time intervals, and the snow profile is intensively examined. Water-soluble dyes are used to emphasize structural characteristics and to trace the movement of melt water in the snow pack. The density, average grain size, hardness, quantity, and distribution of free water and other physical and mechanical properties are measured in the field on each horizon or identifiable storm layer, or on suitable samples. During periods of active metamorphosis associated with frequent or large temperature variations or fluctuations in other meteorological elements, laboratory scientists make continuous diurnal observations and measurements of the physical changes in the snow pack.

Studies to Be Extended

In the main laboratories of the Snow, Ice and Permafrost Research Establishment recently completed in Wilmette, Ill., fundamental research on snow and ice is being undertaken by a staff of physicists and crystallographers which will more precisely define the results obtained at the field laboratory. The extension of the results to additional climatological regimes will be achieved by the establishment of more field laboratories in the northern United States, Alaska, and possibly Canada. Arrangements have been made with the Air Weather Service for the weekly collection of a limited amount of data on the physical properties and extent of the snow cover at a number of its stations in Alaska, the northern United States, Greenland and Canada.

Ultimately it is hoped that from such research the extent, duration, and physical properties of the snow cover over a considerable part of the northern hemisphere can be forecast from standard meteorological data collected at regular, first-order weather stations and available through the U.S. Weather Bureau and Air Weather Service.

The information derived from this research program should ultimately lead to improvements and economies in construction and design practices through the development of mathematical solutions to many engineering problems in areas dominated by seasonal snow. The design of vehicles and other equipment used in snow should also be benefited. Civilian economy as well as military logistics and strategy in snow-covered areas should profit from a comprehensive research program on snow thermodynamics.

PORT of SEATTLE

Double-deck, six-lane concrete viaduct assures Seattle's citizens of quicker, safer transit from home to office. Structure cost $10,627,006 for its 2.4 miles of viaduct and tunnel.

Tunnel and viaduct to ease Seattle's traffic troubles

RALPH W. FINKE, M. ASCE

City Engineer, Seattle, Wash.

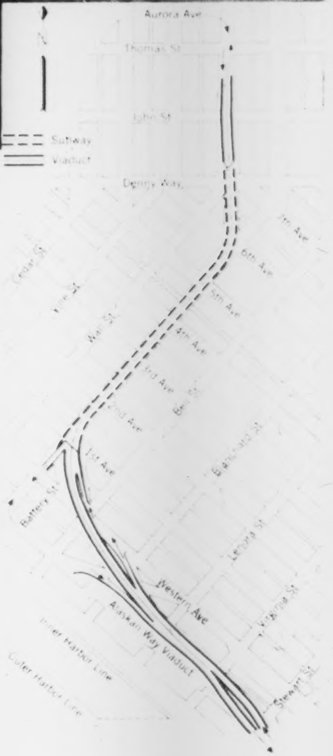

N
Subway
Viaduct
Aurora Ave
Thomas St
John St
Denny Way
7th Ave
6th Ave
5th Ave
4th Ave
3rd Ave
2nd Ave
1st Ave
Cedar St
Vine St
Wall St
Bell St
Battery St
Blanchard St
Lenora St
Virginia St
Stewart St
Western Ave
Alaskan Way Viaduct
Inner Harbor Line
Outer Harbor Line

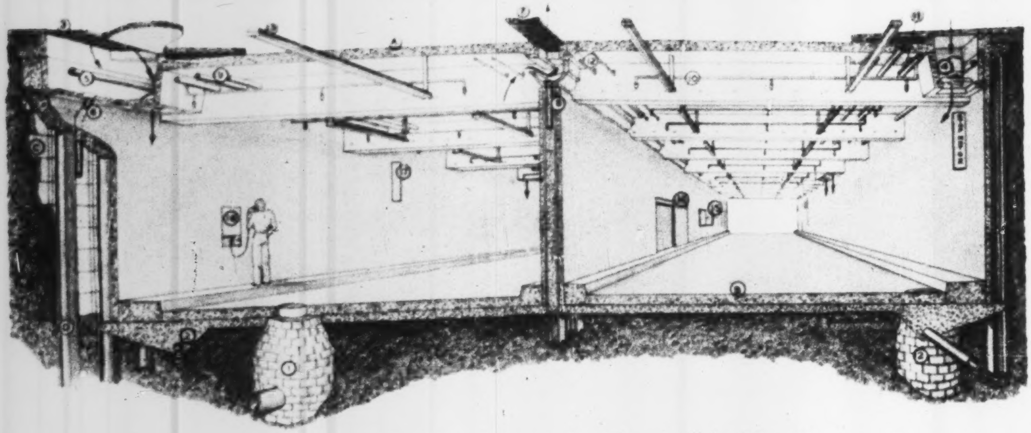
FIG. 1. Alaskan Way Viaduct and vehicular subway speeds Seattle's commuter traffic through once congested business district. Total length of structure is 2.43 miles.

Seattle's double-deck expressway, known as the Alaskan Way Viaduct, is rapidly nearing completion. This structure, constructed under three contracts, together with the connecting Battery Street Subway contract and the lighting contracts recently awarded, will provide a freeway skirting Seattle's congested business and waterfront districts.

Situated between two large bodies of water, Puget Sound on the west and Lake Washington on the east, Seattle has been confined to a north-south expansion. Most of the industrial areas are in the southern part of the city, with the large and expanding residential areas in the north. Principal north-south routes pass through the central business district. As a result the daily flow of traffic to and from work, which has increased 74 percent from 1939 to 1949, has caused unusual congestion.

The first step toward solution of this problem was an origin-destination survey conducted jointly in 1947 by the Washington State Department of Highways and the Traffic Division of the Seattle Engineering Department. This survey showed that, between 9:00 a.m. and 6:00 p.m., 50 percent of the 75,000 cars entering the central business district went through without stopping.

As a result of these surveys, routes were recommended for two expressways passing through the central business district. One of these routes, then designated as the University–6th Avenue–Beacon Hill route and since adopted as the route of a proposed freeway, skirts the easterly edge of the central business district and requires an entirely new right



Battery Street Vehicular Subway

A Upper roadway, 42 ft wide
B Lower roadway, 25 ft wide
C Precast concrete liner plates, where required*
D Steel H piles

1 Sewer main, manholes 300 ft apart
2 Subway drain, catch basins 300 ft apart*
3 Ventilation intake vents, 45 ft apart*
4 Ventilation fans, two per intake vent*
5 Ventilation conduits*
6 Intake vent drains*
7 Ventilation exhaust vents, 15 ft apart
8 Exhaust vent drains
9 Two city light conduits*
10 Automatic sprinkler system*
11 Thermostatic release for sprinkler system*
12 Conduits for subway lighting*
13 Fluorescent subway lights, 15 ft apart*
14 Fire door, one per block
15 Hydrant & fire extinguisher, one per block
16 Utility service telephone, one per block*
17 Emergency "Stop Motor" sign, one per block*

* Occur on both sides of subway

FIG. 2. Section across Battery Street Vehicular Subway shows how air is drawn into structure from street level. Contamination of air is monitored by controls which automatically operate fans in each of eight sections. If the concentration of carbon monoxide exceeds 4 parts per 10,000, signs automatically stop traffic through tunnel.

of way. The other, the Alaskan Way route, follows existing platted streets and connects with existing semi-expressways at each end. The Alaskan Way route was selected for first development because it could be built faster and at lower cost. The central business district lies on a hillside overlooking the harbor and the new viaduct will skirt the foot of this hill, leaving only the docks between it and the water. Little condemnation of right of way was necessary but some damages were paid as a result of infringement of rights of light, air and access. The traffic survey revealed that six vehicular lanes would be advisable, with interchanges to the central business district.

A double-deck structure was found to be the solution to the problem of providing six lanes in the space available, and to maintaining access to abutting property at ground level. Each deck will carry one-way traffic to permit right or left turns to the business district.

Present viaduct construction starts with ramps at the southern terminus, which will comprise a traffic interchange when ultimately developed. Traffic is guided over these ramps to the 4,502-ft double-deck structure, and through an elevated transition structure which brings the decks together to form a single roadway. Then the roadway runs into a 2,134-ft subway, which crosses under seven principal streets, to emerge at Aurora Avenue for a total uninterrupted traffic flow of 2.43 miles (Fig. 1).

Provisions for future ramp connections to the business district have been made at locations where ramps, leading from the 55-ft-high upper deck of the viaduct to the streets, can be practically level.

A double-deck structure, while attractive from a traffic standpoint, presents many problems not found in a simpler design. For such a structure, it was necessary to use only two columns per bent and to spread the columns to accommodate the lower deck. With 14-ft curb lanes, a 12-ft center lane, and an additional 1½-ft curb width, a total distance of 43 ft was necessary between columns. At proposed connecting ramps a 12-ft acceleration or deceleration lane was added, increasing the distance between columns to 55 ft.

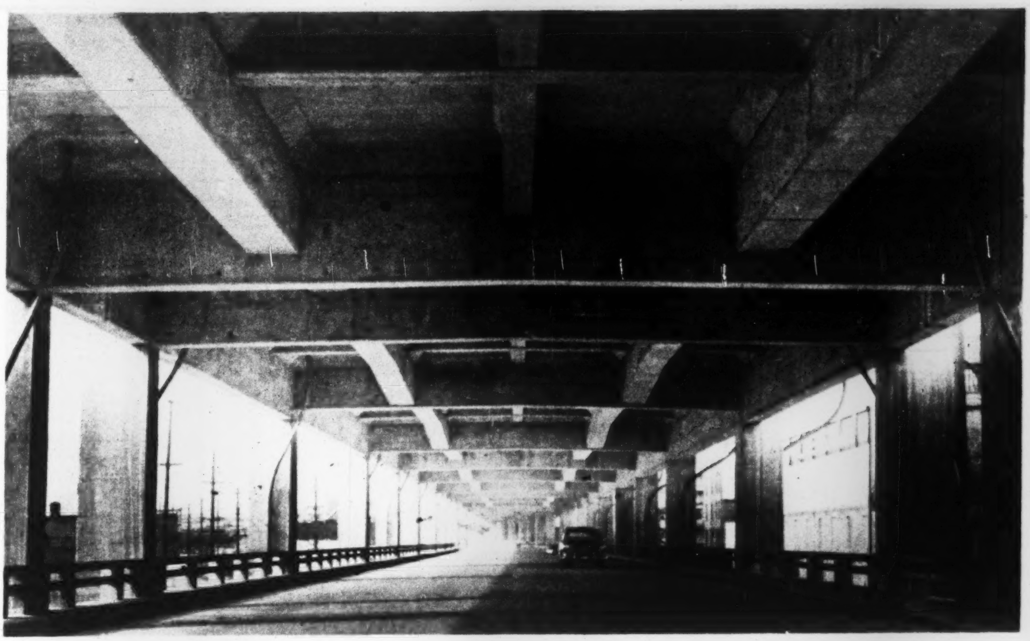
Additional problems included special span lengths up to 86 ft, three-span rigid-frame construction, necessity for railroad clearance under the lower deck and highway clearance between decks, and design for Zone II earthquake load. In a total of 1¼ mile of viaduct structure there is no exact duplication of three-span units.

Early cost studies of structural steel and reinforced concrete designs favored concrete slightly. Material shortages at present have proved this a fortunate circumstance. A total of 35,200 cu yd of concrete and about 4,900 tons of reinforcing steel are required in the double-deck part of the structure. About 2,600 tons of the reinforcing steel will be 2-in. square bars, rolled and fabricated in Seattle and shipped to the job by truck.

Subsurface explorations, consisting of test pits, test borings, test piles and pile loadings, disclosed that a good foundation could be had with relatively short piling and shallow footings. Since parts of the viaduct are over filled beach areas, steel piles were selected, with mandrel-driven poured-in-place concrete piles as an alternative.

Contracts and cost data are given in Table I.

To make the best use of a limited construction area, Morrison-Knudsen Co., Inc., and Rumsey & Co., joint venturers on the contract for the main or double-deck part of the viaduct, acquired two Washington (Model 28-105) revolving gantry cranes. These cranes operate along the west side of the viaduct with the



Width of lower roadway made use of outboard columns necessary, which complicated design problems and affected economy of structure. Vertical clearance between decks is 14 ft 6 in.

gantry spanning one railway track, permitting trains to pass beneath the crane between the gantry legs. The height of these cranes permits easy handling of materials on the upper deck 55 ft above the ground.

Foundation piles consist of either 53-lb steel H-piles or Raymond cast-in-place concrete piles. Steel piles were used in the areas where buried beach logs and other refuse might cause difficult driving. The steel piles vary in length from 52 to 70 ft and the concrete piles from 20 to 52 ft. Timber pile bents were driven to support the lower deck forms and left in place until the upper deck was completed. Completion of the viaduct in December 1952, will provide a usable structure before completion of the Battery Street Subway.

The subway joins the viaduct at the north end and carries traffic under seven heavily traveled streets on a 2,134-ft, four-lane underground roadway, emerging on Aurora Avenue, the principal artery approaching Seattle from the north. This route will become part of U.S. 99 and Primary State Highway No. 1.

The subway is confined within the margins of a 66-ft-wide street and consists of two 25-ft roadways with 3-ft emergency sidewalks separated by a solid dividing wall (Fig. 2). A curve at each end of the subway is constructed on a spiral and superelevated to provide for a safe speed of 45 mph.

Closing of important surface streets during construction, and the resulting tie-up in vehicular traffic, including transit busses, has led to the adoption of a tight construction schedule. Only two of the seven streets may be closed at one time under this schedule and it is expected that none of them will be closed to traffic for more than ninety days. The problem of getting traffic back on these cross streets quickly, together with possible problems of foundation settlement of the buildings along Battery Street, has led to a unique method of construction.

Construction will be by open cut, with the surface roadway being replaced as a ceiling for the subway. Steel H-piles on 3-ft 9-in. centers will be driven along each side wall of the subway and capped with a reinforced concrete beam arranged to act as a wale and as a seat for the deck beams. These beams are precast reinforced concrete members placed transversely on 15-ft centers and they act initially as struts between the outside lines of steel H-piles and later as the beams carrying the deck slab. These precast beams are also supported at the center wall by steel piling. Where necessary, precast concrete liner plates placed between the steel piling, as the excavation is made, will protect adjacent property and foundations against subsidence.

Test borings and experimental test-pile driving disclosed as foundation material a hard-packed glacial deposit of very fine sand similar to hard-packed clay. It was found that steel piling could not be successfully driven through this material without jetting and, even with jetting, could not be driven straight. The answer to this problem was found in preboring a hole for each pile. It was found by tests that 12-in.-dia auger equipment, with extended rack, could prebore a hole to a very close tolerance and that the walls of the hole would stand until a steel pile was set in and driven. The required bearing value of the pile is attained by controlling the depth of preboring.

Placing of precast concrete beams follows closely behind the pile driving, and the cross streets are repaved before making further excavation. Between cross streets, the top deck or ceiling is not replaced until after excavation and other work requiring gasoline-driven equipment is completed.

Gantry cranes used by contractors Morrison-Knudsen Co., Inc., and Rumsey & Co. easily reached upper deck, 55 ft above ground. Cranes straddled one railway track, permitting trains to pass between gantry legs.

Safety features of the subway consist of a ventilation system automatically controlled by carbon monoxide sampling and recording equipment, and automatic deluge-type sprinkler system, fire extinguishers and hose connections, emergency telephones, traffic control signals, and a lighting system. (See Fig. 2.)

The ventilation system is unique in itself, inasmuch as it draws air from and discharges air into the street above by means of fans of the axial flow type. These fans are 33 in. in diameter, powered by 3-hp electric motors, and spaced at 45-ft intervals in each roadway of the subway. A total of 72 individual fan units is required. The air is taken from the surface at the sidewalk level and blown into the subway with sufficient velocity to cover the lower roadway and, after mixing with the contaminated air, it seeks its own outlet through the ends of the subway and through gratings along the center of the surface street. These gratings are 2 ft wide, continuous between cross beams, and are arranged so that alternate gratings vent each half of the subway. This system eliminates the need for large and costly ducts, a central blower plant, and the standby equipment common to normal tunnel construction.

Tests were made of the ventilation fans under simulated conditions to test their capacity and performance. The design provides 265 cfm of air per lineal foot of two-lane subway, thereby changing the air in the subway every two minutes.

Prefouling of the surface air by surface traffic was tested under the most adverse combination of traffic and weather conditions, and the greatest concentration of carbon monoxide sampled was 0.002 percent, indicating a rapid dispersal of toxic gases. Adding the exhaust gases from the subway would double the quantity to be dispersed at street level, but the resulting effect will be well within safe limits. The ventilation fans are automatically controlled by the carbon monoxide testing and recording equipment located in a central control chamber. When the carbon monoxide concentration reaches 2 parts in 10,000 in any one of eight separately controlled sections, the fans in that section will start and operate for two minutes, or until the carbon monoxide content falls below one part in 10,000. Should the build-up of toxic gases continue to rise to 4 parts per 10,000, a sign reading "Subway Closed" will stop traffic at the entrance to each side of the subway. At the same time a warning will be relayed to the police alarm system. In case of local power failure, a "Power Off" warning is likewise relayed to the police alarm system. From observations of the Lake Way Tunnels in Seattle, it is believed that the piston action of the vehicles will take care of normal ventilation needs and that the mechanical ventilation system will operate only under emergency conditions caused by stoppage or slowing of traffic.

Emergency closing of the subway detours the traffic to surface streets and does not present the traffic problem that would be found in closing a tunnel running through a ridge or under a waterway.

An automatic sprinkler system of the deluge type, will be provided to operate in sections. This dry pipe system will be controlled with automatic valves operated by heat-responsive devices and supplemented with an automatic alarm system which will be connected to the central control chamber and the Seattle fire alarm system. It is believed that this is the only vehicular subway or tunnel to have such a system of fire control. The fire which occurred in the Holland Tunnel in New York, with the resulting damage to the tunnel, the loss of vehicles, and the potential loss of life, were factors which led to this provision. In addition, fire cabinets, each consisting of a hose connection for two fire hoses, and two 20-lb fire extinguishers of the dry chemical type (Dugas), are located at 325-ft intervals along the center wall. The cabinets are available to each roadway.

Emergency escape doors are provided in the center wall near each fire cabinet so that escape from a fire on one side of the subway is possible. These doors will also be useful to firemen or police in an emergency.

Other emergency equipment includes telephones placed at 325-ft intervals on each side of the subway and directly connected to the central control chamber. In the absence of a guard, connection is made with the Police Department switchboard. At the entrance to each roadway of the subway, "Subway Closed" signs are provided, and in the subway, at 200-ft intervals, "Stop Motor" neon signs are provided. These are controlled manually from the central control chamber. In case of a wreck or other emergency in one side of the subway, the "Subway Closed" signs can be flashed on at both entrances, leaving one side free from vehicles, and easily accessible to police cars and ambulances.

Lighting of the subway is provided by fluorescent luminaires placed over each traffic lane on 15-ft centers. Each luminaire will contain two 72-in. T12 fluorescent lamps operating at 430 milliamps. Luminaires will be mounted flush with the bottom of the deck beams at a height of 14 ft 6 in. above the subway pavement. An average light intensity of 7.5 foot candles with uniform brightness and little glare is expected as a result.

The entrance lighting problem was solved by providing a bank of mercury vapor lamps mounted in floodlights inside the entrance. They are screened from the driver's eye by mounting them behind the ceiling beams, and are adjustable for direction of light. An intensity of 100 foot candles at the portal tapers off in 300 ft to the level of illumination in the subway.

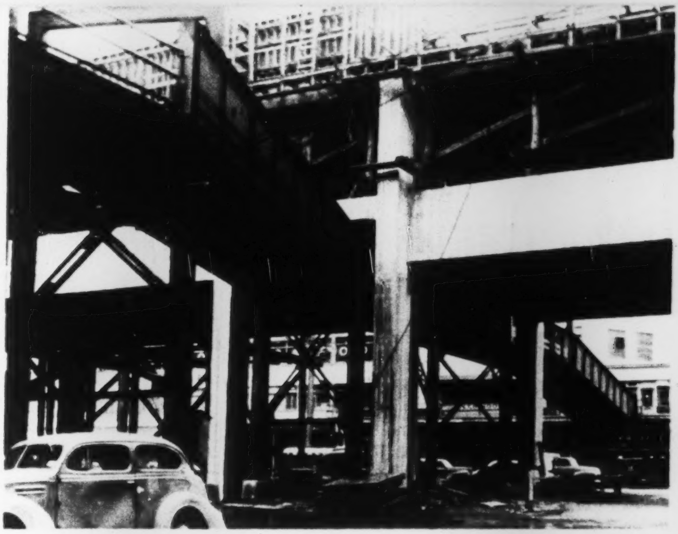
The entrance lights will be energized by a photoelectric cell to turn them on in the daytime and off at night. A similar system of entrance lighting has proved successful in the Lake Way Tunnels. The effect of driving from the bright sunlight outside to the relative darkness of the subway will be comparable to driving into the shadow of a tall building.

A control chamber, located at the midpoint of the subway, will be the key point from which the subway will be operated. Because of the elimination of a large blower plant, this chamber will be a compact unit containing the carbon monoxide sampling and recording equipment, and a control panel for handling all emergency controls. An observer at this point can watch the traffic in both roadways of the subway. It is anticipated that a single guard will be stationed here during peak traffic hours and that emergencies at other times will be handled by the Police and Fire Departments through the alarm system.

Maintenance work will be handled by the city's regular maintenance crews, with one or more men trained for the special equipment involved.

Construction of the Battery Street Subway will finish the north approach to the Alaskan Way Viaduct. Completion of the entire project involves an extension of the viaduct structure to the south, and the construction of four ramps to the central business district. Funds for this work have not been made available at present.

Design work and preparation of plans and specifications were done by the Engineering Department of the City of Seattle, with H. W. Tyler, A.M. ASCE, as principal design engineer, and the author as city engineer. R. M. Murray, M. ASCE, was design consultant. Checking and approval of plans and specifications were handled by the Bureau of Public Roads and the State Department of Highways. Fred J. Dixon is district engineer for the Bureau. William A. Bugge, M. ASCE, is director of highways; George Stevens, M. ASCE, is bridge engineer; and D. D. Forgey is district engineer for the state. Supervision of construction is performed by the State Department of Highways with Corwin A. Pilon, A.M. ASCE, resident engineer, in immediate charge of construction.



Pedestrian overpass runs through viaduct between ends of two 3-span longitudinal girders. Roadway slab was cantilevered over walkway.

TABLE I. Alaskan Way Viaduct and Battery Street Subway—Cost and Provision for Cost

Contracts Let:

	Unit	Contractor	Bid	
1	North approach	MacRae Bros	$1,693,911.85	
2	Main or double-deck section	Morrison Knudsen Co Inc Rumsey & Co	3,691,400.00	
3	South approaches	MacRae Bros	1,063,659.25	
4	Battery Street Subway, and approaches	Morrison Knudsen Co Inc	2,384,061.00	
5	Lighting for viaduct sign bridges, directional signs	Northwest Engineering Electric Co	148,534.00	
	Total			$8,981,566.10

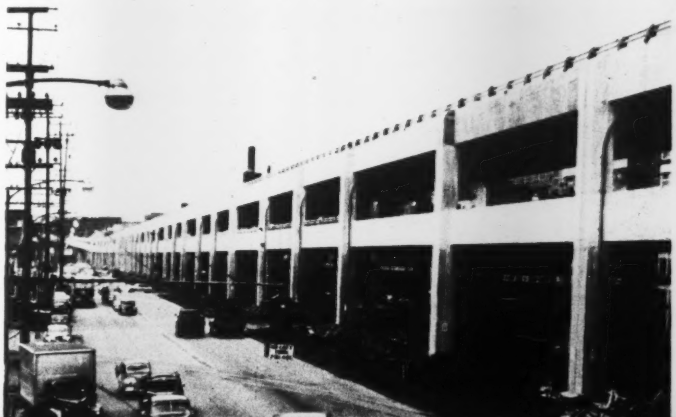
Additional Costs:

Right of way	$1,220,000.00	
Relocation of underground utilities	68,484.50	
Engineering design, subsurface investigations	356,955.38	
Total		$1,645,439.88
Total Cost of Project		$10,627,005.98

Funds were provided as follows:

City of Seattle	$5,860,625.00
State of Washington (Motor Vehicle Fund)	$2,459,783.00
Federal Aid	$2,306,608.00

Concrete viaduct is made up of 3-span continuous girders. Abutting sections meet at split columns. Space beneath viaduct, shown nearing completion, will provide room for parking and roadway to serve nearby warehouses.



Farthest advanced of two incinerator plants now under construction by the City of New York is Gansevoort, in lower Manhattan, on Hudson River. Its capacity of 1,000 tons of refuse in 24 hours is expected to be available for operation in April 1953.

New York City

C. A. ROGUS, M. ASCE

Director of Engineering,
City Department of Sanitation,
New York, N.Y.

Over the years, New York City's disposal methods for refuse—including garbage, rubbish and ashes—have ranged from dumping at sea and reduction plants to the present sanitary landfills and mechanized incineration. Sea dumping was stopped by a U.S. Supreme Court decree on July 1, 1934, as a result of complaints by New Jersey shore communities. The reduction process, which successfully handled a substantial amount of the city's refuse in the early part of this century, was discontinued around 1918 as uneconomical. Similarly, the several manual-type incinerators were discontinued in the early depression years of the 1930's in favor of the cheaper landfill method.

Landfills in turn have had a rather spotty career. Law suits resulted in the development of improved sanitary controls and operational methods by public health experts. A short period of relaxed controls brought forth another cycle of strong public protests in 1947. Engineered plans and controls of a permanent nature were then set up. Close adherence to these plans and controls has now made this type of disposal nuisance-proof and has reclaimed upwards of 1,500 acres of non-usable marginal land for planned future recreational, housing and industrial use. An additional 3,000 acres have been earmarked for similar reclamation, mostly however for the future disposal of incinerator residue and domestic coal ashes.

Notwithstanding this success with landfill disposal and its substantially lower costs, the limited availability of submarginal lands has required an early development of a sound program to conserve such sites for the long-range disposal of coal

TABLE I. Tons of Refuse Collected in New York City in 1950 (Values shown are for equivalent months, each of 30.41 days,

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
	Collected by Dept. of Sanitation										Privately Collected	
Month	Garbage & Rubbish	Coal Ashes	*Domestic Incin. Residue	Street Sweepings	Litter	Ashes for Resale	Total	Permit Cartmen Garbage & Rubbish	Coal Ashes	Swill	Fats, Bone, Etc.	Other to Private Disposal
Jan	244 300	96 900	8 450	7 850	4 950	11 400	372 850	41 500	113 500	14 200	19 100	11 900
Feb	234 400	96 500	8 050	7 850	4 150	12 000	365 950	49 200	94 200	16 900	20 100	14 200
Mar	253 300	73 000	9 450	8 050	4 450	10 400	380 650	62 400	78 900	16 200	16 700	13 400
Apr	218 900	45 600	7 300	8 300	4 550	4 850	289 700	64 600	61 000	17 200	16 100	33 400
May	244 300	24 000	8 450	8 300	4 450	1 550	281 250	71 400	51 400	18 200	14 700	38 300
June	245 300	10 800	8 400	8 400	5 400	500	278 800	76 400	47 800	20 200	13 100	39 500
July	223 200	6 700	7 750	8 300	5 350	290	251 590	68 900	36 200	20 100	12 800	38 400
Aug	223 100	6 200	7 750	8 300	5 200	200	250 750	72 100	36 200	20 200	12 800	38 400
Sept	218 400	14 300	7 300	8 280	4 550	300	253 530	65 300	51 900	20 200	15 100	39 400
Oct	250 400	29 300	9 350	8 280	4 450	960	319 740	65 100	59 200	18 200	15 700	32 500
Nov	237 900	57 300	8 900	8 050	4 550	4 850	341 550	56 400	76 200	17 200	16 100	13 700
Dec	246 300	88 700	8 450	8 040	3 950	10 400	365 840	43 800	113 500	14 200	17 700	11 900
Total	2 901 500	540 000	100 000	98 000	55 000	57 700	3 752 200	737 100	820 000	213 000	190 000	325 000
Lb per cap per calendar day	2.32*	0.37†	0.52‡	0.07†	0.04§	0.04†	2.60†	0.50§	0.55§	0.14§	0.13§	0.22§

* Population base is 6,842,000 (resident population less those served by domestic incinerators)
† Population base is 7,892,000 (total resident population)
‡ Population base is 1,040,000 (those served by domestic incinerators)
§ Population base is 8,192,000 (resident population plus estimated 300,000 equivalent transient population)

turns to incineration

Betts Avenue plant is prototype of proposed refuse incinerators in program to bring New York City's incineration facilities up to date. This plant, placed in operation in June 1950, was described by Frederick H. Zermuhlen in Civil Engineering for April 1950. Its unprecedented design contributed to the initial operating difficulties common to all new plants. These have been progressively eliminated so that it is now operating effectively to its full design capacity of 800 tons per 24 hours. Concurrent extensive research on alleviating fly ash emissions should result in a satisfactory installation at Betts Avenue by early 1954.

ashes and incinerator residue. Accordingly, in 1948 the city administration directed an acceleration of the incinerator construction program.

Alternate disposal methods were concluded to be either impractical or uneconomical. Hog feeding farms, now handling about 4 percent of the total refuse disposed of by the Department of Sanitation facilities, are limited in capacity and present inherent major sanitary and health problems. Mechanical shredding, in either home or central grinding apparatus, and subsequent handling at sewage treatment plants, would entail some costly reconstruction of existing sewer systems as well as costly additions to sewage treatment plants. Composting by either the batch type or the continuous type process is still inadequately developed for serious consideration for use on the scale required in New York City. The reduction processes are far too costly, particularly when anti-nuisance measures are included. Most importantly of course, all these alternates are limited to putrefiable food wastes, which amount to less than 20 percent of our total annual refuse output.

Incinerators, with their ability to accommodate all the refuse, obviate the need for dual collection and disposal systems. Furthermore, the near-central locations which can be utilized for them, as compared with the more distant locations required by the alternates and by landfills, effect substantial savings in haulage costs. This saving is large since New York City's costs for refuse haulage by truck at this time average 30 cents per round-trip ton-mile.

Although costlier than landfill disposal by some 50 percent, incineration effects a near-complete destruction of organic material and produces a reasonably stable end product—about 12 percent by volume of the input. This overall reduction in volume, taken in conjunction with its other advantages and economies, recommends incineration for New York City.

Incinerator Capacities

Evaluation of incinerator capacities requires a determination of: (1) probable economic life of plant, (2) maximum population to be accommodated within this life, (3) maximum refuse output by this population, (4) daily and seasonal variations in this output, (5) frequency of refuse collections, (6) composition of the refuse, (7) merits of segregating non-burnable from burnable refuse, and finally (8) an evaluation of trends and effects of sociological and technological improvements.

1. Life. A generally accepted economic life for municipal structures in this category is 40 years, while the life of the mechanical apparatus in the structure, because of characteristic wear and obsolescence, is limited to 15 or 20 years. However, since such equipment is readily replaceable and averages only 25 percent of the total cost of the plant, the overall economic life was estimated at 40 years. Accordingly the designs of the structures are to be governed by the maximum potential capacities within this 40-year period.

2. Population. Careful reviews of population studies by the Consolidated Edison Co., Regional Planning Association, Federal Bureau of the Budget, and others, developed a future growth pattern. This trend, when fitted to the known 1940–1950 census figures, developed the Department of Sanitation curve with its estimated population peak in 1970—a peak that is well within the 40-year design life. (See Fig. 1.)

A population equivalent of 300,000 people per 24 hours was added to allow for the refuse output of the estimated 600,000 non-resident business people and visiting transients.

Since the estimated population peak for the city lies well within the

to present a truer picture of seasonal variations)

(13)	(14)	(15)	(16)
Other City & Fed Depts to D.S. Disposal	Garb & Rub to Domestic Incin	Total	Total
2 750	37 700	240 650	613 500
3 600	35 800	231 000	569 950
3 700	42 300	233 600	614 250
3 550	33 500	229 350	519 050
3 350	37 600	234 950	516 200
3 650	37 800	238 450	517 250
3 250	34 500	214 150	465 740
3 800	34 500	218 000	468 750
3 550	33 500	228 950	482 480
2 450	41 600	234 750	554 460
13 600	39 500	232 700	574 250
2 550	37 700	241 350	607 190
49 800	446 000	2 780 900	6 533 100
0.03‡	2.33‡	1.86‡	4.37‡

economic life of the planned structures, the program is geared to a maximum population of 8,600,000.

3. Refuse Output. New York City's solid waste products are now collected and disposed of by both municipal and private forces. Consequently an exact determination of sources, variations, types and amounts of materials now prevailing presents a complex and laborious problem. Table I shows the major subdivisions of the several types of refuse now collected in the city. Columns 1 to 5 inclusive show computed subdivisions of the department's collection reports on total, unsegregated refuse. Seasonal variations were depicted more accurately by adjusting reported values to equivalent months, each with an equal number of calendar days. (In May 1949, the department changed its reporting from the previous ambiguous, deceptive volume basis to the present, more accurate weight basis.) The noted subdivisions are essential for a proper extrapolation of each type of material to the 1970 population and conditions.

The per capita value (see Table I) of 4.57 lb of total refuse in all categories requiring disposal appears substantially higher than that normally used by sanitary engineers. The more significant figure of course is the 3.23 lb per capita per day of combustibles and some non-combustibles planned to be processed through future incinerators.

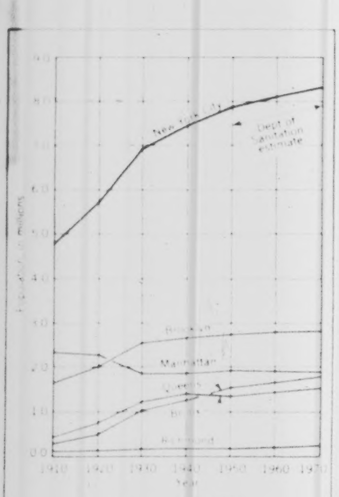
4. Variations. Each value in Table I was projected to 1970 conditions and then plotted in suitable groupings (see Fig. 2) to illustrate the problem of seasonal variations in amounts of materials requiring disposal. Thus, although the materials privately collected show but small monthly variations, those collected by the Department of Sanitation show the winter maximum (mostly accounted for by ashes) to be about 152 percent of the summer minimum. The range of seasonal variations for all the city refuse, shown in the top graph, is substantially less since the maximum winter value is but 135 percent of the minimum summer value.

In order to check the accuracy of the borough-wide and city-wide reports on monthly refuse collections, since they form the base of all future estimates, accurate daily weighings were made in Sanitation District 35 for a whole year. These values, being representative, were extrapolated on a city-wide basis and found to check the basic reports.

It is significant to note that of the total 6,533,100 tons of solid city wastes, the Department of Sanitation collects 57 percent and private industry 43 percent. It is also noteworthy that the benefits of the estimated increased use of domestic incinerators (about 286,000 dwelling units) will be offset by the increased load on all city incinerators because of the probable future discontinuance of disposal at hog feeding farms.

The effect of the incinerator program on future types of refuse disposal is outlined in Table II. Thus although only 19.8 percent of the total city refuse is now incinerated, by 1970 the amount is estimated at about 50 percent of the city total, or over 4,000,000 tons. Landfills, including marine fills, will have reduced their amounts from the present total of 3,750,000 tons, or 53 percent of the 1950 total, to about 1,950,000 tons, or 24 percent of the 1970 total. Taking into account the differences in the specific gravities of the materials now and in the post-incinerator period, this represents a reduction in volume of about 14,000,000 cu yd annually a much needed saving to conserve the fast dwindling tidal lands available for fills.

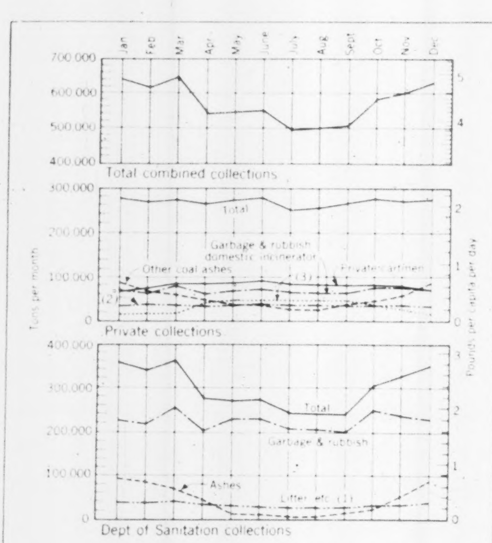
5. Collection Frequencies. Although the daily variations in refuse output are quite pronounced, with maximum peaks on post-Sunday and post-holiday collection days, their effect on general capacity require-



Borough	Population 1950	Population 1970
Manhattan	1,960,101	1,929,000
Bronx	1,451,277	1,542,600
Brooklyn	2,738,175	2,827,400
Queens	1,550,849	1,791,900
Richmond	191,555	236,300
Total	7,891,957	8,327,200

Left:

FIG. 1. **New York population curve has been prepared by Department of Sanitation, based on population studies, adjusted to 1950 census figures, and extrapolated on basis of estimated trend to 1970.**



Notes (1) Includes domestic incinerator residue (approx 1/3), street sweepings (approx 1/3), litter (approx 1/6) and ashes collected by Dept of Sanitation for resale (approx 1/6).
(2) Includes swill (approx 1/2) and fats, bones, etc (approx 1/2).
(3) Includes other refuse disposed of privately (approx 7/8), and refuse collected by other City Departments and the Federal Government but disposed of by Dept of Sanitation (approx 1/8).

Right:

FIG. 2. Curves for city-wide refuse collection, 1970, are based on data given in Table I.

Number	Name of Incinerator	Capacity Tons per 24 Hrs		Nature of Construction
		Present	Proposed	
D-3	Gansevoort	—	1,000	Under construction
D-7	W. 56th St	710	1,200	To be rehabilitated
D-10	E. 73rd St	330	660	To be rehabilitated
D-12	E. 139th St	320	600	To be rehabilitated
D-15	W. 215th St	760	750	To be modernized
D-22	Central Bronx	—	1,000	New construction
D-27	Zerega Ave	670	710	To be modernized
D-32	Hamilton Ave	530	600	New construction
D-39	Coney Island	—	1,000	New construction
D-40	Greenpoint	480	600	New construction
D-43	Central Brooklyn	—	1,000	New construction
D-44	South Shore	—	1,000	Under construction
D-48	Mill Basin	480	600	New construction
D-58	Betts Ave	—	800	Recently completed
D-61	Flushing	340	1,000	New construction
D-78	Richmond	100	500	New construction
Totals		4,720	13,020	

LEGEND

- ● Existing incinerator to be modernized or rehabilitated
- ■ Existing incinerator to be abandoned
- ◉ New incinerator
- ········ Tributary areas for each incinerator

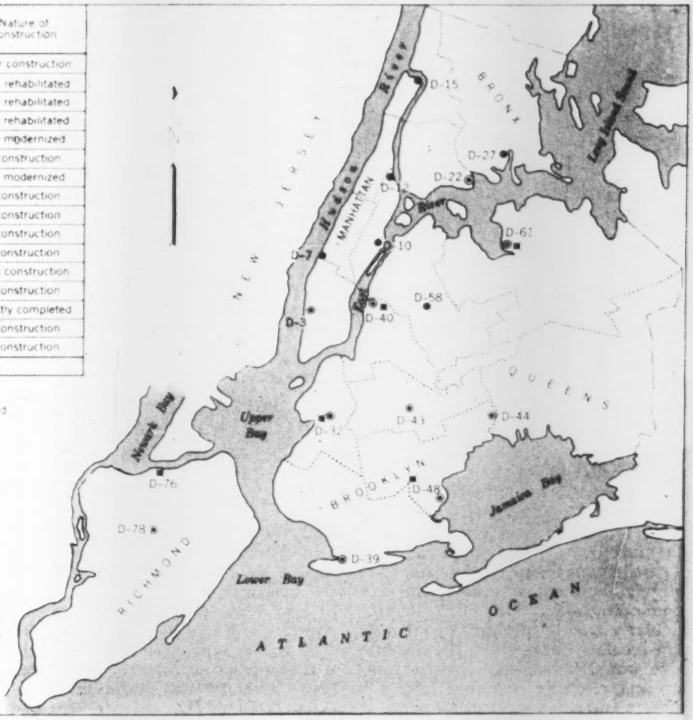
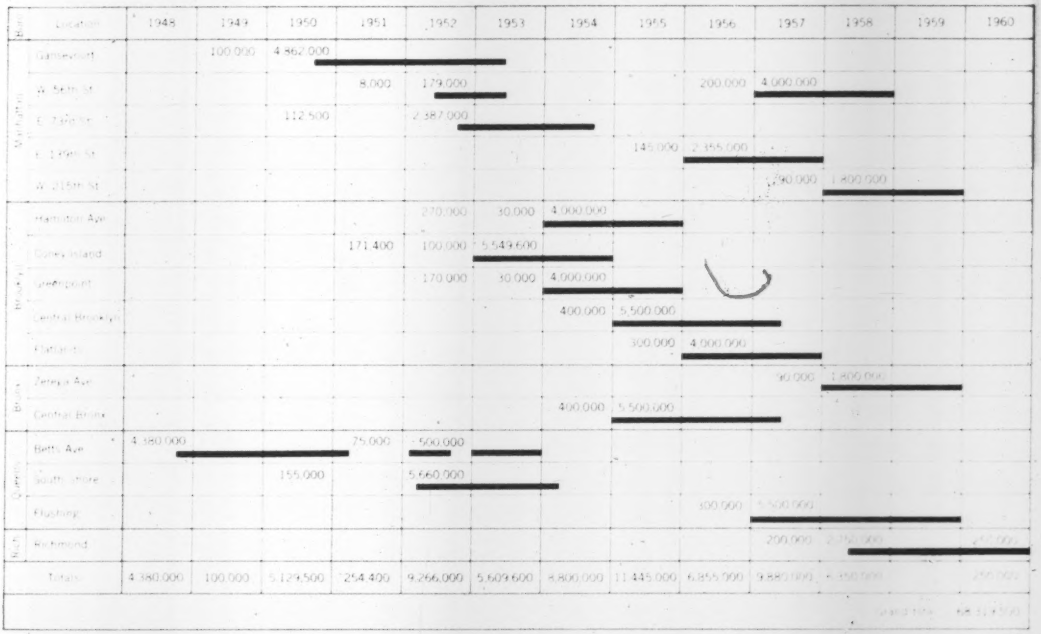


FIG. 3. **Map shows incinerators and their tributary areas in City of New York.**

Below: FIG. 4. New York's program of incinerator construction, showing approximate expenditures and construction schedule from 1948 through 1960, includes 16 plants in five boroughs.



Boro	Location	1948	1949	1950	1951	1952	1953	1954	1955	1956	1957	1958	1959	1960
Manhattan	Gansevoort		100,000	4,862,000										
	W. 56th St				8,000	179,000				200,000	4,000,000			
	E. 73rd St			112,500		2,387,000								
	E. 139th St								145,000	2,355,000				
	W. 215th St										90,000	1,800,000		
Brooklyn	Hamilton Ave					270,000	30,000	4,000,000						
	Coney Island				171,400	100,000	5,549,600							
	Greenpoint					170,000	30,000	4,000,000						
	Central Brooklyn							400,000	5,500,000					
	Flatlands								300,000	4,000,000				
Bronx	Zerega Ave										90,000	1,800,000		
	Central Bronx							400,000	5,500,000					
Queens	Betts Ave	4,380,000			75,000	500,000								
	South Shore			155,000		5,660,000								
	Flushing									300,000	5,500,000			
Rich.	Richmond										200,000	2,750,000		250,000
	Totals	4,380,000	100,000	5,129,500	254,400	9,266,000	5,609,600	8,800,000	11,445,000	6,855,000	9,880,000	6,350,000		250,000

Grand total 68,319,500

At site in east Brooklyn, near Jamaica Bay, South Shore Incinerator was recently placed under construction. Like the Gansevoort Incinerator, soon to be completed, capacity of South Shore plant will be 1,000 tons of refuse per 24 hours.

ments is largely overcome by the frequent collections. The six collection per week for 50 percent of the population, and three collections per week for the remainder, flatten out the inordinate daily maximums. These frequencies, incidentally, are largely dictated by health and economic considerations. This is particularly true in the highly congested low income areas, where the alternative would be a much costlier pickup and cleaning of refuse from the streets and sidewalks.

6. **Composition.** Refuse is a heterogeneous material with an ever varying composition. A comprehensive study of the composition of New York City refuse, made in the late 1930's, is documented in the report, "Survey of Landfill Characteristics, New York City," published in 1941. Carefully controlled analyses of the contents of 168 collection trucks (about 3,500 cu yd) hauling refuse from three of the city's five boroughs and taken over a period of one year, gave the composition shown in Table III. Inclusion of food wastes now collected by private cartmen from restaurants, hotels and meat markets, and of rubbish similarly collected by private cartmen from all commercial establishments, would have a negligible effect on this composition. Although the exact subdivision of materials varies with each year, the figures given are a reliable overall guide for a long-range analysis.

It is worth pointing out that the high ratio of ashes in New York City refuse emphasizes the need for their separate collection and direct disposal in landfills. Similarly it points up the necessity of conserving landfill sites notwithstanding the ever increasing use of gaseous and liquid fuels.

7. **Segregation of Non-Burnables.** Exclusive of ashes, non-burnable refuse constitutes about 25 percent of garbage and rubbish. Its processing through the incinerator would increase the construction and operating costs but little, since the capacity of major incinerator elements is largely dictated by the needs of the burnable materials. Furthermore, the large added cost to the public for dual containers, combined with the cost and difficulty of enforcing separation, makes the plan unattractive. A detailed cost analysis supports our decision to process all refuse, except ashes, through the incinerators.

8. **Other Factors.** An extensive study of the present and future benefits of house incinerators indicates a

TABLE II. Effect of Incinerator Program on Future Types of Refuse Disposal

D.S. = Dept. of Sanitation, City of New York

Disposal Method	Amount in Tons	% of Total
1950 methods:		
D.S. incineration	1,397,000	19.8
D.S. ashes resold	57,700	0.8
Fat rendering	190,000	2.7
Hog feeding	213,000	3.0
Domestic incineration	446,000	6.3
D.S. marine fill	1,809,000	25.6
D.S. landfills, including incinerator residue	1,945,000	27.5
Other privately collected and disposed	1,014,000	14.3
Totals	7,071,700	100.0
1970 methods:		
D.S. incineration	4,024,000	49.9
D.S. ashes resold	57,500	0.7
Fat rendering	203,000	2.5
Domestic incineration	845,000	10.5
D.S. landfills*	1,955,000	24.3
Other privately collected and disposed	973,000	12.1
Totals	8,057,500	100.0

* This amount includes [illegible] tons of incinerator residue.

TABLE III. Monthly Distribution by Weight of Fill Material Based on Sorting and Classifying of 168 Truck Loads of Fresh Fill Material, in Percent

	Organic				Inorganic					
Month	Food Refuse	Misc	Paper	Wood	Metal	Glass	Ashes	Total	Total Organic	Total Inorganic
January	3.7	3.0	12.4	0.3	4.3	4.0	72.3	100.0	19.4	80.6
February	9.0	1.7	12.6	0.7	6.6	4.9	64.5	100.0	24.0	76.0
March	9.7	2.1	20.6	0.3	7.4	7.3	52.6	100.0	32.7	67.3
April	18.1	2.8	21.6	2.0	7.4	6.9	41.2	100.0	44.5	55.5
May	26.7	3.3	23.0	3.1	7.1	6.8	30.0	100.0	56.1	43.9
June	35.1	3.8	24.3	4.6	6.4	6.8	19.0	100.0	67.8	32.2
July	43.8	4.1	25.5	5.9	6.6	6.3	7.8	100.0	79.3	20.7
August	23.1	7.4	37.6	3.8	11.6	5.1	11.4	100.0	71.9	28.1
September	12.6	5.6	26.7	4.9	8.2	9.1	32.9	100.0	49.8	50.2
October	10.1	3.8	31.0	2.6	8.9	4.0	39.6	100.0	47.5	52.5
November	6.6	1.9	18.0	2.1	3.8	2.9	64.7	100.0	28.6	71.4
December	3.5	0.8	9.0	0.8	3.1	1.9	80.9	100.0	14.1	85.9

probable daily load reduction of about 700 tons. This benefit however will be more than canceled out by the probable future discontinuance of disposal at hog feeding farms and the possible discontinuance of fat rendering plants. Neither garbage grinding nor composting seems to be feasible on the large scale required by the City of New York. Decreased wastes resulting from the anticipated enlarged quick-freeze industry may be offset by larger outputs common to the probable higher standards of living. Salvaging of component materials, as a means of reducing amounts to be processed through incinerators, is dependent on too many variables, most important of which is the ever varying salvage market, to be given serious consideration in planning this program.

Incinerator Capacities Studied

In the light of the preceding considerations and many others, the amounts of materials to be processed in 1970 through the proposed incinerators were calculated as shown in Table IV. Both the monthly and daily values were adjusted to allow for the 310-day average yearly operation of incinerators. The contrast between the city-wide monthly and daily demands and the proposed design capacity is obvious. The programmed 13,020 tons per 24 hours will provide an excess capacity of about 5 percent for seven months. Conversely, it will require a 6 percent overload operation for the other five months. This is a happy medium in the interest of optimum construction economies. In so far as operation is concerned, the small excess city-wide capacity should facilitate maintenance and repairs. Short time overloads on the other hand are feasible since they will only result in less than complete combustion for short periods—a permissible solution.

Subdivision of the city-wide capacity among individual plants was dictated by the need of integrating as many existing incinerators as was consistent with sound planning and long-range economy. The number, location and size of each plant was largely governed by the overall objective of achieving maximum efficiency of operation with minimum attendant nuisances, at the lowest possible construction and operating costs.

Existing Plants Examined

Continuance of present plants, particularly in highly developed areas, through modernization and possible enlargement, would meet with public acceptance and, in some instances at least, effect substantial economies. Each of the 11 existing plants was therefore examined as to age, condition and possibilities and cost of modernization and enlargement. Increased utilization of the site for the desired construction of an adjoining Department of Sanitation garage and marine transfer station was a further important consideration. As a result of such studies, it was decided to modernize and increase the present capacities of the East 73rd, East 139th and West 56th Street, Manhattan; and to modernize the West 215th Street, Manhattan, and Zerega Avenue, Bronx, plants. The Hamilton Avenue, Greenpoint, and Flatlands incinerators in Brooklyn are scheduled for abandonment in favor of nearby more suitable sites to accommodate, in each instance, an incinerator, garage, and marine transfer station. The remaining three incinerators—Ravenswood and Flushing in Queens and West New Brighton in Richmond—are to be totally abandoned in favor of new construction on more suitable sites. For a description of the Betts Avenue incinerator, recently completed, see the article by Frederick H. Zurmuhlen in CIVIL ENGINEERING for April 1950 (p. 17).

The size of each new plant was fixed at 600, 800 or 1,000 tons per day. Recent experience indicates that furnace designs of 200 to 250 tons per day each would provide adequate operating flexibility consistent with minimum capital and annual expense costs. Sizes of plants scheduled for modernization were fixed following some preliminary studies on their adaptability for increased mechanization and enlargement.

Sites for incinerators were placed as close as possible to the center of gravity of the refuse produced within the area to be serviced. This theoretical location, producing least haulage costs, was modified where necessary by such considerations as probable public acceptance, zoning regulations, type of probable future development of the neighborhood, availability of inexpensive land of adequate extent to accommodate in most instances the combined incinerator, garage and marine transfer station, height restrictions imposed by the Civil Aeronautics Administration, and foundation conditions.

In most instances the choice of specific sites was left to be made just prior to time of design. Premature site selection with attendant purchase would unnecessarily tie up capital budget monies, would reduce

(Continued on page 102)

TABLE IV. Estimated Input of Refuse Into Incinerators in 1970, in Tons

Month	D.S. Collected Garbage & Rubbish	Privately Collected Garbage & Rubbish	D.S. Coal Ashes*	P.C. Coal Ashes*	Street Sweepings	Street Litter	Scow	From Other City & Fed. Depts.	Total† Per Month	Total per‡ Av. Op. Day	Percent of Design Total (13,020 tons per day)
Jan.	226,200	43,700	18,400	2,500	8,225	4,175	15,050	2,900	321,150	12,430	95.3
Feb.	216,700	51,900	17,000	2,070	8,225	4,375	17,850	3,780	321,900	12,450	95.5
Mar.	254,700	66,000	13,800	1,730	8,475	4,700	17,100	3,900	370,405	14,330	110.0
Apr.	202,700	68,200	8,400	1,315	8,725	4,800	18,150	3,750	316,040	12,240	93.8
May	226,200	75,400	2,700	1,130	8,725	4,700	19,225	3,530	341,610	13,210	101.0
June	232,200	80,700	2,000	1,050	8,850	5,700	21,325	3,850	355,675	13,760	105.5
July	206,200	72,700	1,300	795	8,725	5,625	21,225	3,430	320,000	12,380	95.0
Aug.	206,000	76,000	1,300	795	8,725	5,450	21,350	4,010	323,630	12,520	96.2
Sept.	202,200	68,900	2,700	1,140	8,700	4,800	21,325	3,750	313,515	12,130	93.2
Oct.	250,200	68,700	5,000	1,300	8,700	4,700	19,200	2,570	360,370	13,930	106.8
Nov.	238,600	59,500	10,600	1,675	8,475	4,800	18,150	14,350	356,150	13,790	105.6
Dec.	228,100	46,300	16,800	2,500	8,450	4,175	15,050	2,680	324,055	12,550	96.3
Total	2,690,000	778,000	100,000	18,000	103,000	58,000	225,000	52,500	4,024,500		

* Coal ashes are assumed unsegregated amounts: 20 percent of total domestic for D.S. collection and 10 percent of the industrial coal ash portion collected by private cartmen.

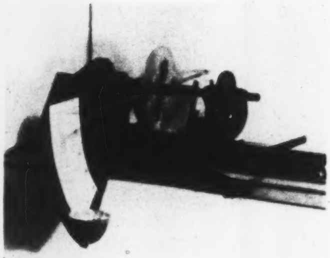
† Values shown per month are adjusted for an equivalent 30.41 day month (365/12).

‡ Values shown per day are adjusted daily requirements in recognition of the fact that incinerators operate on the average of 310 days per year.

ENGINEERS' NOTEBOOK

Home-made apparatus makes accurate torsion tests

W. F. SAUNDERS, A.M. ASCE, Consulting Engineer, St. Louis, Mo.



Home-made apparatus for torsion tests was set up with wood lathe, simply constructed torsion arm, and conveniently graduated scale.

Simple apparatus put together in a basement workshop can often give information that is useful to the designing engineer. The torsion tests here described show the degree of accuracy that can be obtained with such simple equipment. The purpose of these tests was to determine roughly the relative resistance to torsion of a cylindrical section, a half cylindrical section with the same radius as the cylinder, and a flat section with a width equal to the developed half cylinder all with the same thickness.

One specimen of each shape was tested. All specimens were cut from the same length of seamless brass tubing. To form the flat specimen, one half cylinder was annealed, flattened, and annealed again. To make the results comparable, the full cylinder and the half cylinder were also annealed.

Dimensions and shapes of the specimens were as follows:

Specimen No. 1. Shape, flat. Length, 2 [illegible]/32 in. Width, 1 [illegible]/64 in. Thickness, 0.0265 in.

Specimen No. 2. Shape, half cylinder. Length, 2 [illegible] in. Outside diameter, $^3/_4$ in. Thickness, 0.0265 in.

Specimen No. 3. Shape, full cylinder. Length, 15 [illegible] in. Outside diameter, $^3/_4$ in. Thickness, 0.0265 in.

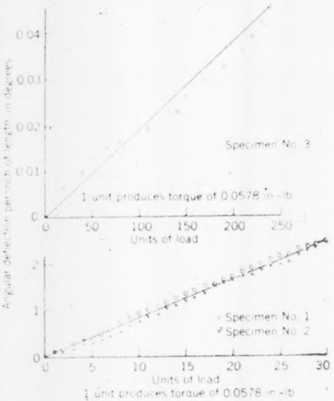
Specimens 1 and 2 were soldered to flat bases at each end, which served as the means for applying torque and restraint. Specimen No. 3 was loaded and restrained by pins through holes drilled in each end. All three specimens were supported by needle-point pins bearing in conical holes drilled in the mountings of the specimens. Torque was applied at one end of the specimen, which was free to rotate but was constrained against axial deflection. The other end of the specimen was held against rotation but was otherwise free to deflect.

The skeleton of the apparatus was a wood lathe, which conveniently furnished a solid base and two ready-aligned shafts. The head-stock bearing was not used (too much friction), well-ground dead centers being placed in both head- and tail-stocks.

Specimens 1 and 2 were soldered to transverse flat brass bars. At the load end, the bar was bolted to an aluminum disk into which was screwed a stud with a conical depression which rode on the point of the head-stock center. To the aluminum disk was also bolted an aluminum rod carrying a pointer, weight pan, and counterbalance pan. The pans were aluminum jelly-molds. At the unloaded end, the brass bar was drilled to ride on the tail-stock center, and this rod also stopped rotation.

Specimen No. 3 was mounted a little differently, because of the much heavier loading. A loading arm separate from the pointer arm was passed through a transverse hole in the specimen, and a pin through a hole in the other end stopped the rotation at that end.

In the photograph, Specimen No. 2 is in position, No. 1 is lying on the bed of the lathe, and No. 3 is below the bed.



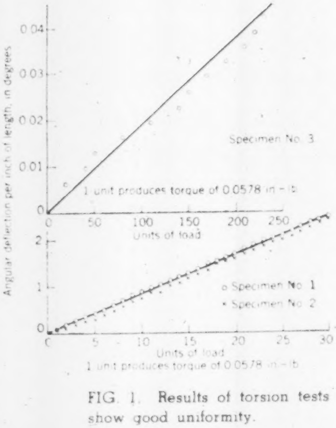


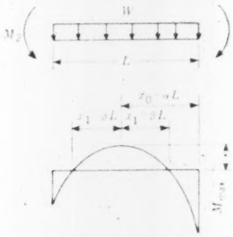
FIG. 1. Results of torsion tests show good uniformity.

THE READERS WRITE

Quick Slide-Rule Calculations for Design of Uniformly Loaded Beams

To the Editor: The chart presented by W. H. Connolly in his article, "Uniformly Loaded Beams Designed by Chart" (May 1952 issue), can undoubtedly be of help to the designing engineer. However, the values given in his chart (p. 51) can be easily obtained by a few simple computations, and many designers prefer a quick slide rule calculation to looking up values on a chart.

Consider the uniformly loaded member shown below.



The quantities to be found are the distance of M_{max} from the support, M_{max}, and the location of the inflexion points. Once the values $\frac{M_1}{WL} = \epsilon$, and $\frac{M_1 - M_2}{WL} = \delta$ are computed, the required quantities can be obtained as follows:

$$\alpha = 0.5 + \delta \qquad (1)$$

$$\beta = \sqrt{\alpha^2 - 2\epsilon} \qquad (2)$$

(The inflexion points are located symmetrically with respect to the point of maximum moment. If the location of the inflexion points is not important, only α has to be computed.)

By multiplying α and β by L, the locations of M_{max} and the inflexion points are found.

$$M_{max} = -M_1 + \frac{WL}{2}\alpha^2 \text{ or } \frac{WL}{2}\beta^2 \quad (3)$$

In the above formulas, in order to follow Mr. Connolly's convention, M_1 and M_2 are introduced with a positive sign when the bottom fibers are in compression and with a negative sign when the bottom fibers are in tension. The sign obtained for M_{max} follows the design convention, that is, positive when the beam sags.

The formulas can be easily derived from first principles.

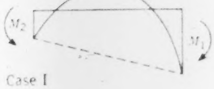
I would also like to point out that Mr. Connolly has underestimated the range of his chart. In the last paragraph he states that the chart "is not applicable if the restraining moments produce tension in the bottom fibers at the support."

As a matter of fact the chart is valid for this case also as long as the correct signs of the moments are taken into account. The rules to follow are:

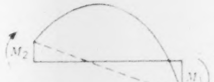
1. M_1 represents the larger support moment when both moments are negative, the negative moment when one support moment is negative and the other positive, and the smaller positive moment when both support moments are positive. (The design convention is used in designating the moments.)

2. The moments should be introduced into the formulas with signs as stated in the preceding paragraph. If both rules are followed, $\delta = \frac{M_1 - M_2}{WL}$ will always be positive.

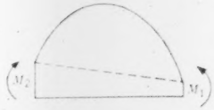
The notations are shown in the diagrams for the three cases below:



Case I



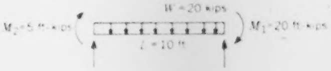
Case II



Case III

The following examples illustrate the use of the chart for the last two cases.

Example for Case II



$$WL = 200 \text{ ft kips}$$

$$\epsilon = \frac{M_1}{WL} = \frac{20}{200} = 0.10$$

$$\delta = \frac{M_1 - M_2}{WL} = \frac{20 - (-5)}{200} = 0.125$$

From Mr. Connolly's chart it is found that the value of the parabolic curve passing through the "zero shear" line intercept with the ordinate of magnitude 0.125 is 0.1955. Accordingly $M_{max} = -20 + 0.1955 \times 200 = +19.1$ ft kips.

The ordinate 0.125 passes through the ϵ curve 0.10 only at the right side of the diagram, indicating an inflexion point at a distance $0.188 \times 10 = 1.88$ ft from the right support. There is no inflexion point at the left side.

These values could have been obtained numerically as mentioned in the first part of the letter.

$$\alpha = 0.5 + 0.125 = 0.625$$

$$\beta = \sqrt{0.625^2 - 2 \times 0.10} = 0.437$$

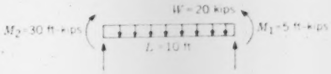
or

$0.625 - 0.437 = 0.188$ in terms of L from right support.

$$M_{max} = -20 + \frac{20 \times 10}{2} \times 0.625^2 = 19.1 \text{ ft kips or}$$

$$\frac{20 \times 10}{2} \times 0.437^2 = 19.1 \text{ ft kips}$$

Example for Case III



$$WL = 200 \text{ ft kips}$$

$$\epsilon = \frac{M_1}{WL} = \frac{-5}{200} = -0.0025$$

$$\delta = \frac{M_1 - M_2}{WL} = \frac{-5 - (-30)}{200} = 0.125$$

Entering the chart on the $\delta = 0.125$ line, the value of $M_{max} = -(-5) + 0.1955 \times 200 = 44.1$ ft kips is obtained. There is no curve $\delta = -0.0025$ and no intercept with the ϵ line, as obviously there are no inflexion points. The values could have been obtained numerically as in the example for Case II above.

Michael Bar Shany, A.M. ASCE

Denver, Colo.

Hydraulic Dredges Effective For Light or Heavy Excavation

To the Editor: Carl H. Giroux's very excellent article, "Modern Hydraulic Dredging—A Product of Experience" (September issue, page [illegible]) will prove a valuable reference work for the entire engineering profession for many years. The only comments I might make are in the way of elaboration.

My company has been designing and building hydraulic dredges for over 65 years. We have noticed, and we hope that it is due partially to our efforts, that modern hydraulic dredges, particularly of the cutterhead type, are being used more and more for heavy excavation work which at one time was considered impractical to do hydraulically.

As an example of the effectiveness of hydraulic dredges, a large unit of our design and manufacture, with approximately 3,000 hp on the pump and 400 to 500 hp on the cutter, has been able to dig and pump the hard tosca formations in the Buenos Aires Harbor of Argentina without resorting to blasting. In the last 3 or 4 years over 10 million cu yd of this difficult material have been dredged from the harbor at a very low cost. Prior to the delivery of this dredge attempts had been made to deepen the harbor with conveyor bucket type units and other non-hydraulic equipment. Outputs were at a very slow and uneconomical rate and the thicker strata had to be dynamited.

Mr. Giroux mentions the very large Elliott-designed Canadian dredge now being built for excavating cemented boulder clay. This further indicates the trend toward designing and building still larger and more powerful hydraulic dredges to take care of special heavy excavation work where the volume indicates a possibility of great economy over other methods.

There is also a notable increase in the use of smaller and efficiently designed portable hydraulic dredges in the 8-, 10- and 12-in. sizes. There has been a growing demand for small units on such jobs as the desilting of water reservoirs, cleaning out of irrigation systems, desilting of chemical plants and refinery ponds, and trenching and backfilling for oil and gas pipeline river crossings. If the number of these smaller dredges in operation could be ascertained, their accumulated output would no doubt be a high percentage of the excavating work done throughout the world.

It is difficult to determine whether the demand for these smaller dredges brought on the creation of more efficient and more economically operating modern units or whether the development of these modern units created the demand. However, civil engineers and their brother engineers should certainly give consideration to the use of some type of hydraulic dredge wherever there is excavating work to be done in or near water.

Carl P. Kaufmann
Vice President and Chief Engineer
Elliott Machine Corporation

Baltimore, Md.

Welding Not Necessary to Remove Rail-End Batter

To the Editor: In my article, "Wheel Impact Damages Rail Ends" (page 52 of the March issue), I made the statement that rail-end batter could be removed without welding. Apparently this statement is confusing to some students, and even to some engineers who have grown accustomed to regard all rail ends as straight except as influenced by batter and who overlook the humping effect of the joint bars on the rail ends as a source of surface irregularity.

A typical profile over joints, on track considered in fair surface, will clarify my position. Figure 1 is a profile obtained by averaging the readings of 25 consecutive joints with reference to a 16-ft taut string extending 8 ft on each side of the joint.

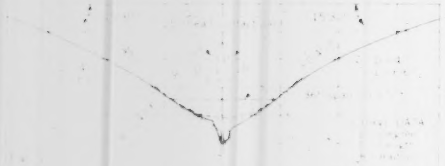


FIG. 1. Profile obtained by average readings of 25 consecutive joints

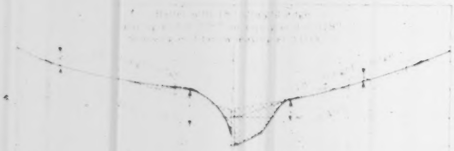


FIG. 2. Enlargement of Fig. 1 under 36-in. straight edge to bring out detail

Figure 2 is an enlargement of Fig. 1 under a 36-in. straight edge to bring out in more detail the conditions within the joint bar limits. These joints were profiled just before treatment by the welding crew, and again shortly after they were welded up and ground. The hatched area shows the weld metal left after grinding, and the shaded area shows the parent rail metal removed by grinding.

Obviously, if these joints had been ground to the 0.45 percent dash lines, and the welding dispensed with, comparable results would have been obtained at far less cost. It is also apparent that if the joints were so ground and tamped to true surface, an ideal condition would result.

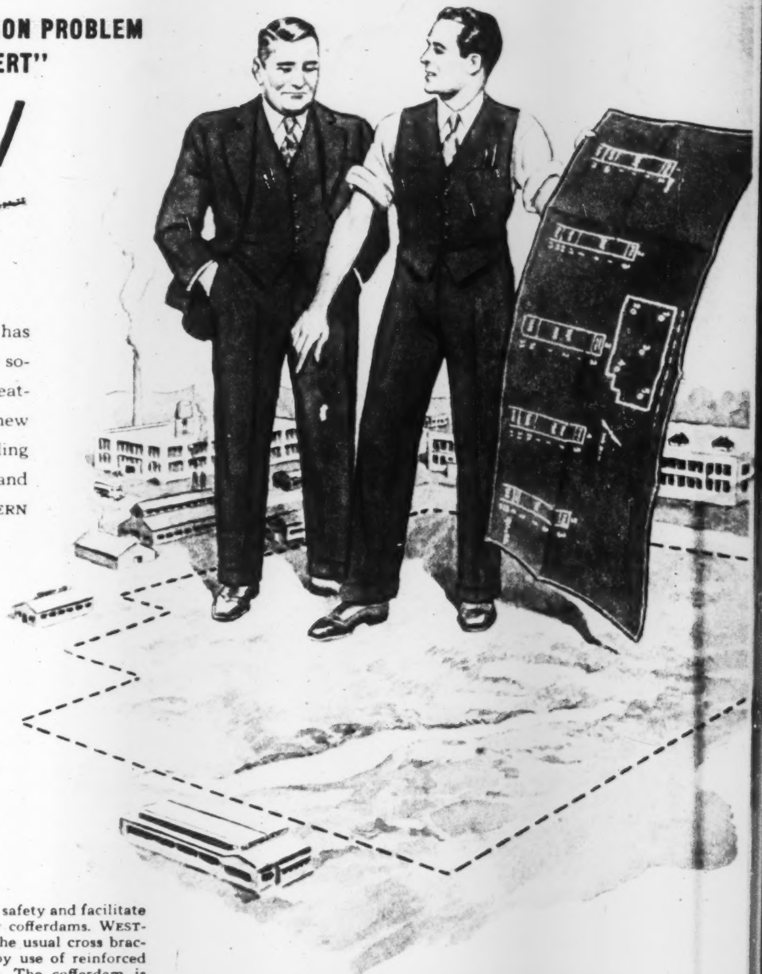
It is interesting to note that some railroads do appreciate the savings that result from such practice. For example, in the August 1951 issue of *Engineering Maintenance*, there was an article, "Programming of Track Work on the Delaware, Lackawanna and Western Railroad," which states that batter is removed by grinding when it does not exceed 0.025 in.

G. W. Hunt
Maintenance of Way Inspector
Baltimore & Ohio Railroad

Baltimore, Md.

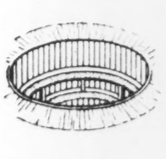
"YOU HAVE A TOUGH FOUNDATION PROBLEM —YOU'D BETTER CALL AN EXPERT"

call Western!



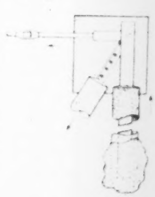
Over the past 25 years WESTERN has continually developed and perfected solutions for foundation problems — creating entirely new types of piles and new foundation techniques — an outstanding contribution to foundation science and practice. Listed below are a few WESTERN innovations developed to meet specific problems.

PROBLEM: To protect the upper section of steel H-piles from corrosion. WESTERN devised an economical method* of scouring the steel and encasing the upper 10 to 30 ft. of H-section in concrete after it has been driven as a pile. Encasing concrete is placed in the dry.



PROBLEM: To assure safety and facilitate work inside circular cofferdams. WESTERN eliminates all the usual cross bracing and "spiders," by use of reinforced concrete ring wales. The cofferdam is entirely open for operation of equipment and for building of the permanent structure. In one case a floating hydraulic dredge was placed inside the cofferdam to speed the excavating.

PROBLEM: To drive a large tip, cast-in-place pile longer than the leads. WESTERN is now driving its standard Button-Bottom Pile* to depths of 100 ft. or more with 90 ft. leads, thus preserving stability and mobility of equipment. An auxiliary section is added to the drive casing and the large button point (227 sq. in. compared with 50 sq. in. for an 8 in. pile tip) is driven to the deep bearing stratum



PROBLEM: To provide a bulkhead of adequate strength where proximity of structures or sliding ground makes the usual buried anchorage impractical. For use with steel sheet pile bulkheads, WESTERN introduced a rigid A-Frame tie-back utilizing a vertical tension resisting Pedestal Pile in combination with a batter pipe or H-Beam compression pile. Pedestal Piles have been tested to 160 tons tension resistance.

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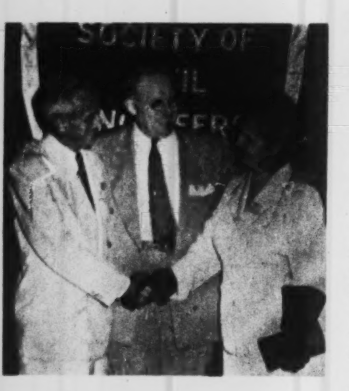
SOCIETY NEWS

MERRY CHRISTMAS ★ HAPPY NEW YEAR

Successful Inter-American Convention Sponsored by ASCE Puerto Rico Section



The words "Mission Accomplished" might well be stenciled across the cover of the program for the Inter American Convention of Civil Engineers, held in San Juan, Puerto Rico, November 12-16. So well were the objectives of the Convention achieved that the Puerto Rico Section—the first to sponsor an event of this type—its president, William C. Hill, and its Convention committee headed by Etienne Totti received the commendation of the nine countries and fifteen states represented at the Convention.

The primary objective achieved was the bringing of a major Society program within traveling range of a large number of interested members during the Centennial celebration. The varied technical sessions, tours, and social events were all enthusiastically attended. Another major objective of the Convention was characterized by the words, "Bienvenidos Amigos," prominently displayed on the program. The strengthening of international understanding, the start of new friendships was so marked as to be the subject of special comment by ASCE Past President Carlton S. Proctor in an address at the final Convention event.

Technical Sessions Feature Local Projects

Of equal interest to the several hundred engineers attending the Convention was the opportunity for exchange of technical information offered by the thirteen sessions planned and conducted by a Puerto Rico Section committee under the leadership of Rafael A. Gonzalez. Program subjects were selected because of their special appeal to engineers of Puerto Rico and its neighboring countries. In addition to local engineers, there were several speakers from South and Central American countries and a number from the states. Particularly interesting were the papers describing the rapidly expanding industry and commerce of the island and accompanying challenges in communication, development of resources, housing, and commercial structures.

From the welcoming addresses at the opening session in San Juan on November 12 to the closing ceremonies in Mayaguez on Sunday, November 16, exceptional hospitality was offered the visitors. Warm greetings were expressed by the Hon. Roberto Sanchez Vilella, Secretary of State and Interior, during impressive opening ceremonies in the auditorium of the

AMERICAN
SOCIETY OF
CIVIL
ENGINEERS

In upper view, Chelsie J. Senerchia, engineer mayor of Miami, Fla., is introduced to Sra. Felisa Rincon de Gautier, city manager of San Juan, by ASCE Past-President Carlton S. Proctor. Photo at left shows Executive Secretary W. N. Carey and Don Reynolds, assistant to the Secretary, arriving at San Juan for Convention. Scene at membership luncheon (below) shows G. Brooks Earnest, ASCE Vice-President, Zone III; Senora de Gautier; Mr. Proctor; Etienne Totti, Convention chairman and presiding official at the luncheon; Mayor Senerchia; W. C. Hill, president of Puerto Rico Section; and Edmund Friedman, ASCE Vice-President for Zone II.

Colegio de Ingenieros de Puerto Rico, with the president of the host Section, William C. Hill, in the chair. Greetings to the Society on its completion of a century of engineered progress and the Puerto Rico Section were presented by delegates from many countries and states and by the president of the college, Gustavo E. Padilla.

Responding to the greetings, Mr. Proctor discussed some of the objectives and accomplishments of the Centennial year, and cited the need for building on the enterprise of engineers throughout the free nations of the world. The "business" of the American Society of Civil Engineers was the subject of a talk by William N. Carey, Executive Secretary, who emphasized the services to members available within this professional society.

Special Briefing for Visitors

For the briefing of visitors, maps and historical summaries were made available. In addition an interesting historical account, prepared by the official historian of Puerto Rico, was presented at the opening session by Antonio Romero. Another unusual service to visitors was a book, prepared especially for the occasion and describing every facet of cultural, commercial, and professional interest in Puerto Rico. The book was a joint enterprise of the host Section and the Colegio de Ingenieros.

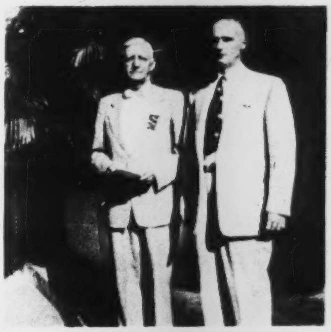
Another emissary from the states to the Convention was the Mayor of Miami, Chelsie J. Senerchia, himself an engineer, who addressed the first membership luncheon on the subject, "Engineers in Public Service." Sra. Felisa Rincon de Gautier, city manager of the capital city of San Juan, also spoke at this luncheon, citing the accomplishments in growth and welfare of her city made possible by the enterprise of its engineers. Later during the Convention she entertained the ladies attending the convention with a musical in her unusual apartment atop City Hall. At a second membership luncheon, the principal speaker was Gustavo Padilla, president of the Colegio de Ingenieros. In his talk, entitled "The Law and the Engineer," he stressed the need for engineers to be better versed in law affecting their work.

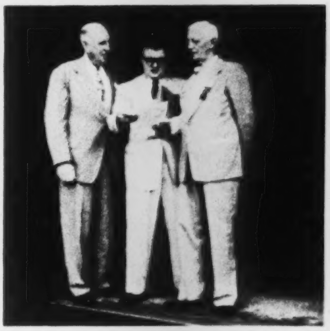
The extent of the technical program makes a brief account utterly inadequate. Some of the papers presented are being published in CIVIL ENGINEERING. Attendance at the technical sessions was augmented by engineers and others released from their offices with express encouragement to attend, a practice that might well be noted by engineers in the states. The result was unusually spirited discussion of the papers presented.

The extensive and varied social program arranged for the event took full advantage of the beauty of the locale and the delightful warm climate. Luncheons, dinners, and cocktail parties were almost continuous throughout the Convention. Special attention was given the ladies in attendance through the thoughtfulness of Mrs. William C. Hill, chairman of Ladies' Entertainment, and her many willing helpers. One notable reception was given by Governor and Mrs. Luis Munoz Marin at Fortaleza, the Governors' Palace.

Student Chapter Visited

The concluding event of the Convention program was an outstanding luncheon and reception, sponsored by the College of Agriculture and Mechanic Arts of the University of Puerto Rico and the recently established ASCE Student Chapter there, held at Mayaguez on Sunday, November 16. On outdoor terraces of the spectacular new engineering building, the hospitality of the hosts was expressed by Dr. Luis Stefani, vice-chancellor of the university, and by several hundred engineers, students, and industrialists.





Welcome to Puerto Rico is extended to visitors (below). Shown, left to right, are the Hon. Roberto Sanchez Vilella, Secretary of State and Interior; Section President W. C. Hill; Past-President Proctor; Etienne Totti, Convention chairman; and Executive Secretary W. N. Carey. In next photo (proceeding counter-clockwise) technical program plans are discussed by ASCE Vice-President George W. Burpee, chairman, Committee on Division Activities; Mr. Hill; and Rafael Gonzalez, chairman of Convention's Technical Program. Next photo shows Mr. Gonzalez and Henrique Siblesz, director, Venezuela Ministry of Public Works. Photographed at Mayaguez reception are Prof. Aurelio Matilla, Faculty Adviser for Chapter at the Colegio de Ingenieros de Puerto Rico; Vice-Chancellor Luis Stefani; and Franklin O. Rose, first Faculty Adviser of the Chapter. Group of Convention speakers is shown in top photo: T. William Lambe, H. O. Ireland, Alfredo Hernandez, Virgilio Ramos, Jose Capacete, and Raoul Arroyo.

San Francisco is as beautiful and interesting at night as by day. Lights of San Francisco Oakland Bay Bridge are visible in background

Plans for San Francisco Convention Mature

At a meeting of the San Francisco Convention general committee in November, plans were crystallized for the March Convention in the city by the Golden Gate. The four-day meeting (March 3-6) includes a well-rounded technical and social program, and an entire day (Thursday) for field trips. Members will have their choice of two all-day trips—one to the Pacific Gas & Electric Company's Pittsburg and Contra Costa Steam Plant, with return via the University of California; the other to the Ames Laboratory of the National Advisory Committee on Aeronautics where a huge supersonic wind tunnel is under construction. The latter trip will return to San Francisco via Stanford University.

Actually Convention activities will get under way on Monday, March 2, with three two-day meetings—regular sessions of the Board, a Student Chapter Conference and a Local Section Conference.

The Convention proper gets under way Tuesday, March 3, with five Technical Divisions (Air Transport, Construction, Engineering Mechanics, Power, and Sanitary Engineering) holding sessions starting at 2 p.m. Scheduled for Wednesday afternoon are meetings of the Hydraulics, Sanitary Engineering and Structural Divisions and a joint session of the Construction and Power Divisions. Friday morning will be devoted to sessions of the Highway, Hydraulics, Irrigation, Soil Mechanics and Foundations, and Structural Divisions, and Friday afternoon to programs of the Highway, Irrigation, Soil Mechanics and Foundations, Surveying and Mapping, and Waterways Divisions. Negotiations are also under way for a session of the City Planning Division.

Mark M. Falk, of the Hotels and Registration Committee, urges members planning to attend the sessions to make their hotel reservations early. Blocks of rooms are being held at the Mark Hopkins and Huntington hotels and at the Fairmont, the headquarters hotel. The rooms will be reserved on a first-come first-served basis.

Hotel reservations and Convention preregistration will be handled separately, with details of pre-registration to be announced in the January issue. Mr. Falk explains that the importance of preregistration stems from the fact that some of the Convention events will of necessity be limited as to attendance. Among these events are the gala Wednesday evening dinner dance that will feature a Hawaiian motif in keeping with the planned post-convention tour. The Ames Laboratory field trip will also be limited as to attendance.

The post-convention tour will include sessions in Honolulu on March 9. Air travel to Hawaii is indicated as there are no convenient ship sailings, but either air or ship travel will be equally feasible for the return trip. Since March is the

Program for forthcoming San Francisco Convention is discussed by (left to right) L. A. Elsener, general Convention chairman; I. C. Steele, ASCE Director from San Francisco; Walter L. Huber, President of the Society; and Rear Admiral Carl E. Trexel, program committee chairman.

height of the travel season, members contemplating the Hawaiian trip should make reservations at the earliest possible data. These reservations—both travel and hotel—should be made through George R. Smith, International Travel Service, 210 Post St., San Francisco 8, Calif. A deposit of $50 is required with each individual Hawaiian reservation.

Publicity committee for Society's San Francisco Convention gets some publicity for itself. Seated are Louis Riggs, Jr.; James Ballard, ex-offico; Ralph Whitaker, Jr.; Graham Steel; Larry Wise, chairman; and Clarence Rinne. Val Padovan and Jack Long are standing.

Sections Select Seven Wonders of Civil Engineering

CHARLES M. BAYER

Public Relations Consultant, ASCE

If the constructors of the Seven Wonders of the ancient world were to come to America today and gaze upon the achievements of the Century of Engineered Progress, might they not be sufficiently impressed to concede that "these modern fellows are not so bad themselves"? And might they not find that today there are seven times seven wonders—and more?

The fabulous creators of the ancient world's Seven Wonders cannot be here to sit in judgment on us. But we may sit in judgment on ourselves. Thus, some months ago, the ASCE suggested to the Local Sections that it would be of considerable interest and of undoubted regional publicity value if they were to designate the seven wonders of their respective areas.

Some Sections have done so and, in a number of instances, with important publicity results. Others are in the process of making their choices. The attendant publicity can have two good effects—helping acquaint the public with the aims and accomplishments of civil engineering in the development of civilization and better living and serving as an inspiration to students whose interest in engineering is desired.

The Cleveland Section, in particular, has done outstanding work in obtaining publicity for itself. It indicated its choices to the press so well that the *Cleveland Plain Dealer* devoted four rotogravure pages to photos and descriptive stories. In considering the list of "candidates" the Cleveland voters took an engineering point of view, of course, with substantial emphasis on planning for the future. Here are the results.

1. The Terminal Tower Group of six buildings. The 52-story tower is the tallest building in the world outside New York City, with foundations going down 240 ft to bedrock—Cleveland's only building resting on rock.

2. The Cleveland Municipal Stadium, the nation's third largest. It was built on fill land on the lakefront, seats 80,000, and with temporary seats has accommodations for 6,000 more. It cost about $4,000,000.

3. The Main Avenue Bridge, spanning the Cuyahoga River with 110-ft arches. Including approaches the over-all length of this structure is 7,950 ft. It was opened in 1939 at a cost of $7,200,000.

4. Cleveland's Shoreway and Freeway System. Cuyahoga County has 18 miles of completed freeways costing $37,529,000. The proposed highway express system calls for about 90 miles more. The Gordon Park link—a particularly expensive mile of highway construction, at $6,837,000—involved building a seawall, many bridges, a grade separation and interchange.

5. The municipal water system. The new $21,000,000 Nottingham Station is capable of delivering 100,000,000 gpd. Three intake tunnels extend from 3½ to 5 miles into Lake Erie.

6. Metropolitan parks, encircling Greater Cleveland from Rocky River to North Chagrin with 14,000 acres of natural beauty.

7. The Cleveland Museum of Art in Fine Arts Garden, said to have the most beautiful setting of any art museum in the world.

The Cincinnati Section has come forward with these wonders:

1. The Suspension Bridge, completed in 1866, outstanding for its time and still in effective service. It is said to have been the first connecting link between the North and South completed after the Civil War.

2. The Ingalls Building, erected in 1903, one of the first "tall" structures of completely reinforced concrete construction in the United States.

3. The Cincinnati Water Works, started in 1897 and completed in ten years at a cost of $11,500,000. The Section's report said of it, "The whole system, including the new tunnel and pumping system at Tennyson Avenue and the new Westwood storage tank, represents an outstanding development. The filtration plant at California is one of the finest in the country."

4. The Cincinnati Southern Railway, first and only city-owned railway in the world. The 338-mile line, which runs from Cincinnati to Chattanooga, was started in 1869 and completed in 1880 at a cost of $45,000,000. It is now operated under lease by the Cincinnati, New Orleans and Texas Pacific Railway, a part of the Southern System.

5. Canalization of the Ohio River, which has contributed greatly to the growth of river traffic. The project was completed in 1929.

6. The $10,000,000 Millcreek Barrier Dam has made floods in Millcreek Valley rare. It pumps out the creek runoff and

protects the valley from the flooding Ohio River. Within three months after it was completed it averted a flood that could have caused at least $2,000,000 damage.

7. A power plant of the Cincinnati Gas & Electric Co.—the Walter C. Beckjord Station at New Richmond.

The Seven Wonders of Washington, D.C., selected by the Centennial Committee of the District of Columbia Council of Engineering and Architectural Societies, are as follows:

1. Major L'Enfant's city plan, still regarded as the most advanced city plan in history.
2. The Capitol dome, made up of hundreds of plates bolted to 13 massive iron ribs supported by ingenious cantilever connections with 72 iron columns embedded in a brick wall.
3. Washington Monument: tallest obelisk ever built.
4. The Old Potomac Lock and Canal System. Engineered by George Washington, the canal is remarkable in that it surmounted the rock barrier around Great and Little Falls in the Potomac in a time of limited tools and low-powered explosives.
5. The David Taylor Model Basin at Carderock, Md., largest installation of its kind for building and testing model ships.
6. The Terrestrial Magnetism Laboratory at Carnegie Institution. It has made important discoveries in nuclear energy, electronics, cosmic rays and related fields.
7. Remodeling of the White House. Rebuilt from cellar to roof, the Executive Mansion is stronger than when originally constructed.

In the Pacific Northwest the Tacoma Section has chosen the following Seven Wonders: (1) Grand Coulee Dam; (2) Tacoma Narrows Bridge; (3) Lake Washington Floating Bridge; (4) the Great Northern Railway's Cascade Tunnel; (5) McNary Lock and Dam; (6) Bonneville Lock and Dam; and (7) Chief Joseph Dam.

In order of preference, the Sacramento Section has named: (1) Trans-Sierra railroad location for the Central Pacific Railroad; (2) Shasta Dam on the Sacramento River; (3) long-distance transmission of power, Folsom to Sacramento, in 1895; (4) the Pelton water wheel; (5) water supply of Virginia City, Nev., with pipe line, inverted siphon, and 1,720-ft head; (6) delta reclamation of Sacramento-San Joaquin rivers; and (7) the hydraulic giant for placer mining.

When all the regional projects have been selected, an interesting and worthwhile opinion as to the Seven Wonders of the United States can be obtained.

Daniel W. Mead Prizes Awarded for Essays on Ethics

Charles E. Negus, Jr.

Howard Payne

Winners of the 1952 Daniel W. Mead Prizes for the best papers on subjects involving professional ethics are Howard L. Payne, J.M. ASCE, winner in the Junior category, and Charles E. Negus, Jr., who receives the Student Chapter award for a paper written while he was a member of the Society's Student Chapter at the University of California. Mr. Payne wrote on the subject, "It Shall Be Considered Unprofessional to Use the Advantages of a Salaried Position to Compete Unfairly with Engineers in Private Practice." Mr. Negus' topic was "My Concept of Engineering as a Profession in Contrast to It Merely as a Job."

Mr. Payne writes that he became interested in civil engineering during a period of military service as an enlisted man in the Military Government organization in Japan. After demobilization, he returned to school, graduating from Stanford University in 1950 in the newly created construction option of civil engineering. He then worked for private engineers in northern California and in the Bridge Department of the California Division of Highways, participating in the design of bridges and freeway structures. At present, he is at the University of Washington, studying for a master's degree and doing research in high-strength bolted joints. Presentation of the prize to him will be made at a West Coast Section meeting later.

Mr. Negus attended junior college at Fullerton, Calif., spent three years in the Army Air Corps, and worked on various construction jobs for three years after the war. Deciding to return to school in 1949, he entered Placer Junior College at Auburn, Calif., and in the following year transferred to the University of California. Since graduation in June of this year he has been employed in the Bridge Department of the California Division of Highways. Mr. Negus will receive his award at the Society's San Francisco Convention in March.

ASCE "Transactions" For 1952 Available

In December, Volume 117 of TRANSACTIONS for 1952 will be available. It contains 58 papers, covering an extremely wide range of topics. Here, in addition to the customary large number of technical papers on the theory of structures, water flow and soil mechanics, will be found the newest conclusions by experts in such fields as electronic surveying, supersonic sounding, prestressed tanks, cartography, valuation, lake traffic, ion exchangers and radioactive tracers, coal bunkers, airports, and fire monitors and nozzles. Modern engineering thought, in the fields of irrigation, highway practice, and regional planning, is traced through Turkey, Mexico, Great Britain, Washington, D.C., and California.

Individual volumes of the current TRANSACTIONS are being mailed to members at the following nominal rates: Paper binding, $2.00; cloth binding, $3.00; and leather-type binding, $4.00.

Reprints of the TRANSACTIONS papers are already in stock for single copy sale. Though the rates are as moderate as present-day printing permits, the cost of even a few single reprints soon exceeds the price of the entire volume. That is, if purchased, the papers in Volume 117 would cost $22.50 ($45 to nonmembers). For best service, orders for the current TRANSACTIONS should be forwarded at once, using the convenient form in the advertising section.

Alabama Section Has Centennial Celebration

The engineering future of southern Alabama was explored in a recent two-day program, sponsored by the Alabama Section in Mobile in celebration of the Society's Centennial. In the technical program which was headed by Col. W. K. Wilson, the outlook for waterways was discussed by H. I. Collins, chief technical assistant of the Mobile District of the Corps of Engineers; for electric power, by F. C. Weiss, vice-president of the Alabama Power Co.; for the chemical industry, by Hans Schmelser, director of engineering operations at Courtaulds (Alabama), Inc.; for highways, by Reese Harvey, state highway director; for the oil industry, by Edward T. Merry, of Mobile; and for heavy industry, by Tom Martin, GM & O works manager for the Aluminum Ore Co.

Trips to three of six great industrial plants under construction in the Mobile area and representing an initial capital outlay of more than $50,000,000, supplemented the technical program, which was voted the most interesting in a number of years. Some 150 members visited the industrial plants, and there was a registration of about 200 for the technical program.

Engineering Secretaries Elect Officers for 1953

New officers for the Council of Engineering Societies Secretaries, elected at the organization's sixteenth annual meeting in Chicago during the Centennial of Engineering, are Henry S. Harris, of the Philadelphia Engineers' Club, president; Ernest Hartford, of the ASME, vice-president; Frank G. Horton, of the Engineering Society of Detroit, secretary; and M. C. Turpin, of the American Society of Refrigerating Engineers, treasurer. Edward H. Robie, of the AIME, and W. N. Carey, of ASCE, were elected directors for one year; Henry H. Henline, of the AIEE, director for two years; and J. Earl Harrington, of the Western Society of Engineers, director for three years.

W. N. Carey, Executive Secretary of ASCE and 1952 president of the Council, presided at the two-day meeting, which was devoted to the exchange of ideas and information regarding the management and operation of engineering organizations. Subjects under study and round-table discussion included headquarters staff job classification, tax problems, today's dues, engineering manpower, insurance, unity, advertising as a means of income, raising funds for an engineering society, ECPD and its training program, promotional material, contacts with local schools, office equipment, mail procedure, and relations between local and national engineering societies.

The Council accepted the invitation of the Philadelphia Engineers Club to hold its 1953 meeting in Philadelphia on Friday and Saturday, June 5 and 6.

Washington, D.C., Engineers Stage Centennial Program

Sparked by the ASCE Local Section in Washington, the District of Columbia Council of Engineering and Architectural Societies staged with signal success its own local celebration of the Centennial of Engineering. The program opened with a Centennial Banquet at the Mayflower Hotel on October 22 and carried through five days with engineering movies and exhibits in the U. S. Interior Department Auditorium. Planned to excite public interest in engineering, the movies were particularly pointed toward prospective engineering students. A number of "science models," built by students in District of Columbia schools, were prominent among the exhibits.

At the dinner Wednesday, October 22, the 600 or more practitioners in the design professions who were present learned of research developments looking toward the commercial use of atomic energy. Arthur Griswold, assistant to the president of the Detroit Edison Co., told of an affiliation of private industrial organizations headed by his company and the Dow Chemical Co., which is privately financing extensive research on the industrial use of heat from nuclear fission. Mr. Griswold estimated that, with uranium at $35 a pound, heat from nuclear fission can be made commercially competitive with normal fuels in electric power stations when the steam side of such stations can be built for $227 per kw of electrical capacity. Steam-side investment costs with present fuels now run between $80 and $90 per kw of electrical capacity, Mr. Griswold stated.

A challenge to engineers to exert public leadership based on their training and practice in the use of logic and cold facts was voiced by ASCE Past President Carlton S. Proctor. He sharply castigated communism, statism, and socialism, stating they "are as false quicksands beneath which our American way of life will sink and smother if we embark upon them." Mr. Proctor was presented to the assemblage by Walter L. Huber, President of ASCE, who extended the greetings of the Society to the group.

Dixon Lewis was chairman of the dinner meeting, and Russell W. Mebs, chairman of the Council of Engineering and Architectural Societies.

Attending Centennial of Engineering Banquet in Washington, D.C., on October 22 are (left to right, reading clockwise) Miss Joyce Gibbons, assistant to Centennial Publicity Committee; Lt. Gen. Lewis A. Pick, Chief of Army Engineers; Vincent B. Smith, president-elect, District of Columbia Section and chairman of D.C. Centennial of Engineering Publicity Committee; William R. Herron, Section director; Jackson Taylor, National Cash Register Co.; Waldo E. Smith, president of Section; Lorenzo Winslow, architect for the White House; Thomas H. Urdahl, consulting engineer; Capt. A. D. Hunter, deputy chief, Bureau of Yards and Docks; and Harry P. Graves, vice-president, McGraw-Hill Book Co.

Story of a Society Manual

Production of the blue-covered occasional publications of the Society—"Manuals of Engineering Practice"—represents an entirely different process from that used in issuing a Society Paper. A Paper is the product of a single author, or the joint product of two or three men. After publication, the Paper may be followed by written discussion and an author's closure.

In contrast, a Manual is drafted by one or more individuals, reviewed and amended by a sponsoring committee, reviewed by a number of selected "experts" who furnish constructive criticisms and suggestions, amended again by the committee, presented to the Board of Direction, which may make further suggestions or amendments, approved by the Board, and finally published together with a historical summary that recites the specific details of the procedure. Thus a Manual, as the product of many minds, represents the best available collective thought in its field. Incidentally, a Manual is authorized only if the material is considered to be not readily available elsewhere to practicing members of the profession.

The Society's Manuals are not voluminous, the current list ranging from 7 to 184 pages, yet the intermediate drafts will have filled many typewritten or mimeographed pages before the final copy is sent to the printer. The accompanying illustration shows the successive drafts of a recent Manual, No. 30 on Job Evaluation and Salary Surveys, which is a relatively simple, nonmathematical production with only a few illustrations.

Manuals cannot be regularly scheduled, so that the required staff time must be found between, or in addition to, continuous assignments. Manual No. 30 was drafted by a member of the headquarters staff who ultimately devoted over 300 hours to the complete procedure. In addition, other members of the staff spent a total of more than 200 hours in typing, stenciling, correspondence, critical review, drafting, styling for the printer, proofreading, and other work necessary to produce the finished product.

This relatively simple Manual serves to illustrate the pains taken in producing Society documents that enjoy a reputation for accuracy and usefulness among practicing members of the profession. A schedule and price list of Society Manuals appears in the advertising section of this issue.

Steps in the procedure of producing Manual No. 30 may be noted here. The binder at lower left contains the first draft, a composite of hand-written and typed pages. Successive drafts are laid out clockwise around the printed manual. The final typed copy that went to the printer is at the right, followed by galley proofs and ending with page proof. Stacked up, this material bulks 7 in. thick. The final product (center) is 6 by 9 in., contains 88 pages, and is only ½ in. thick.

Structural Division Concludes Its Reports

Joint Committee to Study Plate Girders

In recent years, the economical field for plate-girder construction has been greatly extended. Some girders have been built during the past few years with spans of considerably more than 300 ft. They have invaded a field formerly dominated by trusses. These developments have given rise to a number of problems involving design, fabrication and erection. The Joint Committee to Study Plate Girders, of which Neil Van Eenam is chairman, sponsored by ASCE and the American Association of State Highway Officials, was organized to investigate problems of this nature.

The present objective of the committee is limited to a study of web-plate buckling under shearing stress, bending stress and combinations of shear and bending. This will involve an investigation of web-plate thicknesses and of the effectiveness of stiffeners, both transverse and longitudinal. When the behavior of web plates under stress is better understood, it may be found feasible to reduce somewhat the safety factors against buckling and thereby permit reductions in web plate thicknesses. The committee has outlined a comprehensive program of tests and expects to test the first of a series of full-size girders in the near future. Furthermore, reports of similar tests in this country and abroad are studied and compared, in order to avoid duplication of effort. Other problems deserving early consideration are the lateral buckling of the compression flanges of plate girders and stresses in partial length cover plates.

Appropriations Authorized By Executive Committee

Meeting in San Juan during the recent Inter-American Convention, the Executive Committee considered additions to the budget required to meet certain expenditures authorized by the Board of Direction at its New York meeting. It added the following items to the 1953 fiscal budget: (1) $20,000 for publishing a civil engineering Centennial volume similar to a volume of TRANSACTIONS, (2) $1,300 for a Local Section Conference at Miami Beach in June 1953, and (3) $3,000 for a joint meeting of all members of Local Section, Junior Member, and Student Chapter committees, the place not specified.

These appropriations will be covered by the amount that the Society's actual receipts and expenditures, at the end of the current fiscal year, differs from the amounts budgeted at the beginning of the fiscal period.

Freeman Fellowship Open

Members of ASCE or the ASME, who wish to follow through a worthy research program in hydraulics or related fields, are given advance notice that a new Freeman Fellowship will be available this coming spring. The normal period of study is nine months. Details of the award, which is conducted in conjunction with the ASME, will be announced in the January issue.

Oregon Section Sponsors C.E. Refresher Courses

Civil engineers, regardless of membership in ASCE, are invited to join a study group being sponsored by the Oregon Section to prepare for the Oregon State Professional Engineers' examination in civil engineering. Interested persons should get in touch with Walter Bushnell, 9225 S.E. Francis St., Portland.

FROM THE NATION'S CAPITAL

JOSEPH H. EHLERS, M. ASCE

Field Representative ASCE

With a new administration shortly to take over the reins of government, the general view in Washington is that businessmen, contractors and engineers will have an increasing influence in government. Some hasty impressions are (1) That economy in government will be effected through more careful spending rather than by eliminating programs; (2) that military spending will continue to be large while foreign economic aid will be reduced; (3) that taxes must remain high for another year before even moderate cuts can be made, and (4) that public power development and river authorities will be pushed less vigorously." Congress will continue to be somewhat conservative, the new President a little less so. A tendency to leave many problems to the separate states is expected. Business is expected to continue at high levels through most of 1953.

New Administrative Approach

With the exception of the several Cabinet appointments, including Charles E. Wilson, an engineer, as Secretary of Defense, and Gov. Douglas McKay of Oregon for the Interior Department, this column professes complete ignorance in respect to one of the burning questions of the day—namely, who will be the key figures in the technical activities of the new administration. That there will be a new approach to performing the tasks at hand is almost as certain as that there will be new administrators to carry on. As an example, DPA and NPA have held controls regulations in high regard as machinery for use in time of dire national emergency regardless of their actual need in the current situation. The original priorities system for construction was scrapped in favor of the elaborate Controlled Materials Plan on the theory that a dire emergency was possible and that the procedure needed to be perfected through a trial period in order to be adequate to serve in a crisis. We accepted this philosophy and actively participated in conferences designed to make the CMP questionnaire forms as acceptable as possible. As to whether such a system should now be continued for an indefinite period is quite another question. Standby organizations in government have not been successful. Some of the ablest administrators have gone on record unequivocally against them, believing that crises do not follow set patterns, that each crisis is unique and can best be met by a completely new organization.

Construction Controls

With this in mind, efforts have been made to have NPA controls removed for construction except for such situations as indicate an urgent current need for them. If it is a fact that there is an ample supply of steel except for certain heavy plates, large structural shapes and wide-flange beams and if the standby organization philosophy is discarded, then obviously whether controls should be relaxed on April 1 or January 1 or whether two tons or ten tons may be self authorized are petty questions that do not go to the heart of the matter. A concession obtained at a recent meeting by a task force of NPA's own Construction Advisory Committee was that CMP tickets will be valid beyond the quarter for which they were issued. In fact, unused Fourth quarter 1952 tickets will take precedence over regular first quarter 1953 tickets. Meanwhile, structural fabricators are worrying about getting orders for next year.

Need for Establishing Public Works Criteria

At a recent meeting of a new U. S. Chamber of Commerce committee of which ASCE Past President Ezra Whitman has been named a member, there was a discussion of the public works field, particularly in regard to establishing criteria for the needs for highways and other public works. This office has long and vigorously maintained that the establishment of criteria for need in the field of public works is a part of engineering planning and engineering economics, strictly an engineering function. In the field of housing which is subject to the play of forces of a free market, economists not trained in engineering may effectively deal with the establishment of criteria for need but the corresponding function in respect to public works must be handled by engineering planners. It is believed the new committee will have adequate engineering advice and that some new clarifying principles may be stated.

The Paley Report, "Resources for Freedom," was mentioned in this column last month. Parts of the report are essential reading for many engineers and industrialists. Although mining and chemical engineers will be most interested, others should have some acquaintance with this study of our country's resources. The report previews our materials situation for the coming quarter century, making allowances for population growth, increases in productivity, the world supply situation and similar pertinent factors. It does not give final solution but rather may be viewed as posing problems and suggesting approaches.

The National Security Resources Board has reviewed the report and has received suggestions for its implementation from 22 interested government agencies. About two thirds of the approximately eighty suggestions received are believed to warrant some present action. The forthcoming NSRB report will suggest implementation through (1) government aid to private enterprise (research, etc.), (2) improving the economic environment (taxes, etc.), (3) regulatory actions, (4) development of resources where government produces under specific law (nuclear energy, water power), (5) publicly owned resources, (6) efficient use by government as a consumer (specifications for purchase), (7) development of resources of the free world, (8) development of adequate resources for total war, and (9) providing a continuing policy for resources development.

Such a study as the Paley Report often sparks a great conservation meeting. A new group, "Resources of the Future, Inc.," will hold a major national conference in Washington in March 1953. Of extremely great importance to engineers is the fact that this great gathering will discuss not only the Paley Report but also the report of the President's Water Policy Commission and also parts of the Hoover Report relating to resources development and conservation.

Best wishes for the Holiday Season to all our readers.

Washington, D.C.
November 24, 1952

ASCE MEMBERSHIP AS OF NOVEMBER 10, 1952

Members	8,252
Associate Members	10,374
Junior Members	16,727
Affiliates	68
Honorary Members	42
Total	35,463
(November 9, 1951	35,648)

Alfred Noble Prize Goes To Mechanical Engineer

Myron Tribus

This year's winner of the Alfred Noble Prize is Myron Tribus, director of icing research and visiting assistant professor of chemical engineering at the University of Michigan, for a paper "Intermittent Heating for Aircraft Ice Protection with Application to Propellers and Jet Engines," published in the ASME *Transactions* for November 1951.

A mechanical engineer and member of the ASME, Dr. Tribus was educated at the University of California at Berkeley, receiving the B.S. degree in chemistry in 1942 and a Ph.D. in engineering in 1950. He taught at the University of California in Los Angeles in 1941 and 1942 and again from 1946 to 1950. During the war (1942 to 1946) he was a captain in the U. S. Air Force in charge of airplane icing research at Wright Field, Ohio. In addition to his teaching duties at the University of Michigan, Dr. Tribus is consultant to the Aircraft Nuclear Propulsion Division of General Electric on heat transfer problems associated with nuclear propulsion. Author of many technical papers and publications, he received the Wright Brothers Medal of the SAE, in 1945, for his "Report on the Development and Application of Heated Wings," and the Thurman H. Bane Award of the Institute of Aeronautical Sciences for "icing research."

Presentation of the Alfred Noble Prize to Dr. Tribus is being made at the annual meeting of the ASME, held in New York City during the week, November 30–December 5.

Tennessee Valley Engineers Have Two-Day Meeting

The annual fall meeting of the Tennessee Valley Section, held in Chattanooga on November 7 and 8, was attended by about 150 members and their families and guests. ASCE officers at the Friday morning session, devoted to the business of the Section, were Edmund Friedman, Vice President for Zone II; James A. Higgs, Director for District 10; and Assistant Secretary E. Lawrence Chandler. In the balloting for Section officers for 1953, Clifford A. Betts, 1952 president of the Chattanooga Sub-Section, was elected Section president, and Sydney Smith, of the Holston Sub-Section, Section vice-president.

Dr. Raymond R. Paty, director of the TVA, was principal speaker at the Friday luncheon. Other speakers during the two-day program were Albert F. Porzelius, manager of the Chattanooga City Water Co., and Ross H. Bryan, Nashville, Tenn., consultant, whose respective talks on "Aldrich Type Water Filters" and "Prestressed Precast Concrete" constituted the technical program, and David A. Lockmiller, president of the University of Chattanooga, who gave the principal address at the Friday evening dinner dance.

A Saturday morning inspection trip to the Chattanooga Filtration Plant to see the new Aldrich type water filters was followed by a barbecue planned by Mr. Porzelius and his staff.

Photographed at Friday luncheon are (seated, left to right) Dr. Raymond R. Paty, director of TVA and principal speaker and Clifford A. Betts, newly elected Section president. Standing are ASCE Director James A. Higgs; ASCE Vice-President Edmund Friedman, and Don H. Mattern, 1952 president of Section.

Coming Events

Cleveland Meeting at the Cleveland Engineering Society on December 19.

Kansas Meeting in Topeka, Kans., on December 12.

Los Angeles Dinner meeting at the Alexandria Hotel, Los Angeles, on December 10, at 6:30 p.m. The Junior Forum will also meet at the Alexandria Hotel on December 10, at 5:45 p.m. Weekly luncheon meetings of the Junior Forum every Friday at the Hotel Clark Coffee Shop, at 12 noon.

Maine Third annual highway conference sponsored by the Maine Section in cooperation with the Maine State Highway Commission and the University of Maine Student Chapter, will be held at the University of Maine campus, Orono, on December 19 and 20.

Maryland Dinner meeting at the Engineers Club of Baltimore, on December 10, at 7 p.m., preceded by cocktail hour at 6 p.m.

Metropolitan Section Meeting in the Engineering Societies Building, 33 West 39th St., New York, N. Y., on December 17, at 8 p.m. Meeting of the Junior Branch in the ASCE Board Room, 33 W. 39th Street, on December 10, at 7:30 p.m.

Northwestern Dinner meeting at the Curtis Hotel, Minneapolis, Minn., on January 5, at 6:30 p.m.

Philadelphia Joint meeting with ASME at the Engineers' Club on December 9.

Pittsburgh Meeting in the Pittsburgh Room of the William Penn Hotel, on December 16, at 8 p.m.

Providence Meetings on the second Thursday of each month at 8 p.m., at the Providence Engineering Society auditorium.

Sacramento Weekly luncheons every Tuesday at the Elks Temple, Sacramento, at 12 noon.

San Francisco Dinner meeting at the Engineers Club, San Francisco, Calif., on December 16, at 6 p.m. Informal luncheon at the Engineers Club every Wednesday.

Tacoma Annual stag night at the Allenmore Golf Club House, Tacoma, on December 12. Officers for 1953 will be nominated.

Tennessee Valley Holston Sub-Section will hold its annual Family Christmas Party on the evening of December 19.

Branches of Texas Section Elect Officers

The ten Branches of the Texas Section have met in recent weeks to elect new officers for the coming year. They will be as follows:

Austin Branch: W. A. Grasso, president; Robert L. Lowry, vice president; and W. D. Ramey, secretary-treasurer.

Brazos Branch: E. L. Harrington, president; Codie Wells, vice president; and W. H. Nedderman, secretary-treasurer.

Corpus Christi Branch: W. C. Klett, president; W. A. Raatz, vice president; and Henry H. Nau, secretary-treasurer.

Dallas Branch: W. Scott McDonald, president; C. H. Meers, vice president; and L. A. Lankford, secretary-treasurer.

El Paso Branch: H. H. Corbett, president; E. J. Umbenhauer, vice president; and J. R. Bustamante, secretary-treasurer.

Fort Worth Branch: Albert C. Allen, president; Harland H. Hester, vice president; and J. B. Mapes, secretary-treasurer.

Houston Branch: A. L. Rahn, Jr., president; Adrian Pauw, vice president; and R. A. Rait, secretary-treasurer.

Paris Branch: S. Glen Fry, president; J. W. Cravens, vice-president; and H. H. Short, secretary-treasurer.

San Antonio Branch: Lydon A. Gilman, president; W. F. Castella, vice president; and A. L. Kincheloe, secretary-treasurer.

Southeast Branch: Harold A. Barr, Sr., president; Charles L. Davidson, vice president; and W. C. Schoeller, secretary-treasurer.

Soil Mechanics Symposium in Mohawk-Hudson Section

To acquaint the engineer who does not specialize in soils, with the scope, equipment and limitations of the science of soil mechanics, the Mohawk-Hudson Section sponsored an all-day symposium in the field at the Soil Laboratory of the New York State Department of Public Works, Lathams, N.Y., on November 8. Talks of a non-theoretical nature, were given by E. J. Kilcawley, of Rensselaer Polytechnic Institute; G. McAlpin, W. P. Hoffman, W. J. Dennis, and N. Sinacori, of the State Soil Laboratory; and P. C. Rutledge, of the firm of Moran, Proctor, Mueser and Rutledge. More than 75 engineers attended the talks and guided tours through the laboratory.

Part of group of Wisconsin Section engineers attending recent dinner meeting at Racine is shown here. Dinner followed afternoon inspection tour of Oak Creek Power Plant project of Wisconsin Electric Power Co. on shores of Lake Michigan about 15 miles south of Milwaukee. Estimated cost of the completed plant, which was begun in May 1951, is $100,000,000. First 120,000-kw generating unit is expected to go into service soon, though delays in obtaining critical materials may cause postponement until spring. Dinner meeting was devoted to illustrated presentation of design and construction features.

News of Local Sections Briefed

SECTION	DATE	ATTENDANCE	PROGRAM
Buffalo	October 21	61	Luncheon featuring a talk by Harold J. Sykes, construction manager, Stone & Webster Engineering Corp., on what makes a construction job click.
Central Ohio	October 16	14	Dinner meeting. Reports were presented by several Section members on activities at the Centennial of Engineering celebration at Chicago.
Central Illinois	October 16		Prof. T. C. Bannister, head of department of architecture, University of Illinois, spoke on the subject, "The First Iron-Framed Buildings," at a dinner meeting.
Cleveland	October 17	72	Guest speaker, George B. Sowers, consulting engineer, presented a talk on "Shore Erosion and Changing Lake Levels."
Florida			
Jacksonville Sub-Section	October 28	25	Round table discussion of the Jacksonville Expressway, and the Arlington and Gilmore Street bridges was the highlight of the dinner meeting. Richey Green, State Road Department, Stanley Johnson, resident engineer on Arlington Bridge, and C. L. Lash, resident engineer on Gilmore Street Bridge led the discussion.
Northwestern Sub-Section	October 20	24	Discussion of S. A. Greeley's handbook, "Rates and Rate Structures for Water and Sewage Works," was followed by showing of a film entitled, "Corrosion in Action."
Kansas	September 30	93	Prominent guest speakers at dinner meeting included Dean D. V. Terrell, former Vice-President, Zone II, and Ernest E. Howard and Carlton S. Proctor, Past-Presidents of ASCE.
Miami	October 2	24	The Hon. Chelsie J. Senerchia, Mayor of Miami, and an engineer, reviewed current and proposed city projects, at a dinner meeting. Edmund Friedman, Vice-President, Zone II, reported on the Centennial Convocation.
New Mexico	October 25		Fall meeting. Program consisted of business meeting; presentation of papers by W. E. Strohm, bridge engineer, New Mexico

		..	State Highway Department. Howard A. Persons, vice-president and chief engineer, Public Service Company of New Mexico, and John C. Thompson, project engineer, Middle Rio Grande District; luncheon and afternoon inspection of the New Old Town Bridge.
North Carolina	October 15	54	Annual meeting. Newly elected officers include P. D. Davis, president; Edward B. Rice, first vice-president; Ralph E. Fadum, second vice-president; and James F. Pou, secretary-treasurer. Program featured addresses by George D. Whitmore on "Engineering Applications of Photogrammetry," and Moses E. Cox on "Expressway Construction in Atlanta."
Philadelphia	October 14		Joint meeting with the Metropolitan Philadelphia Chapter, American Public Works Association. Samuel S. Baxter, water commissioner, City of Philadelphia, spoke on the general subject of sewage and drainage problems of a large city.
Delaware Sub-Section	October 16	50	Dinner meeting featured a speech by Francis G. Tatnall, manager of testing research, Baldwin-Lima-Hamilton Co., Philadelphia, Pa., on the subject of SR-4 bonded wire strain gauge.
San Diego	September 23	75	Admiral William O. Hiltabidle, district civil engineer in charge of engineering, Eleventh Naval District, described events at the Chicago Centennial; and James Slater, chief public health engineer, San Diego, talked about the proposed City-County Health Department merger.
Tennessee Valley			
Holston Sub-Section	October 21	17	Highlight of business meeting was election of officers for 1953. W. K. Seaman is president, and E. A. McDougle, secretary-treasurer.
Knoxville Sub-Section	October 8	64	Newly elected officers include the following: Oscar L. King, president; and Robert F. Collignon as secretary. Robert P. White, assistant superintendent of the Great Smoky Mountains National Park, described maintenance problems.
Muscle Shoals Sub-Section	October 16	..	Tennessee Valley Section president, Donald H. Mattern, related his experiences at the Centennial of Engineering celebration at Chicago.
Oak Ridge Sub-Section	September 25	..	Speaker of the evening, Henry Dougherty, Portland Cement Association at Memphis, Tenn., reviewed the history of prestressing concrete.
Wisconsin	October 9	89	Dinner meeting featured talks by a panel of speakers on the construction of the Oak Creek Power Plant. Inspection of the plant preceded the meeting.

ASCE Life Member Ralph L. Parshall addresses Colorado A & M Student Chapter on "The Functions of ASCE and What It Can Do for You." In his talk, Mr. Parshall put heavy emphasis on the ASCE Code of Ethics, saying that it must be adhered to if engineering is to maintain its professional status. Mr. Parshall also covered the organizational structure of ASCE, its aims and accomplishments.

Scheduled ASCE Conventions

SAN FRANCISCO CONVENTION

Fairmont Hotel
March 2–7
1953

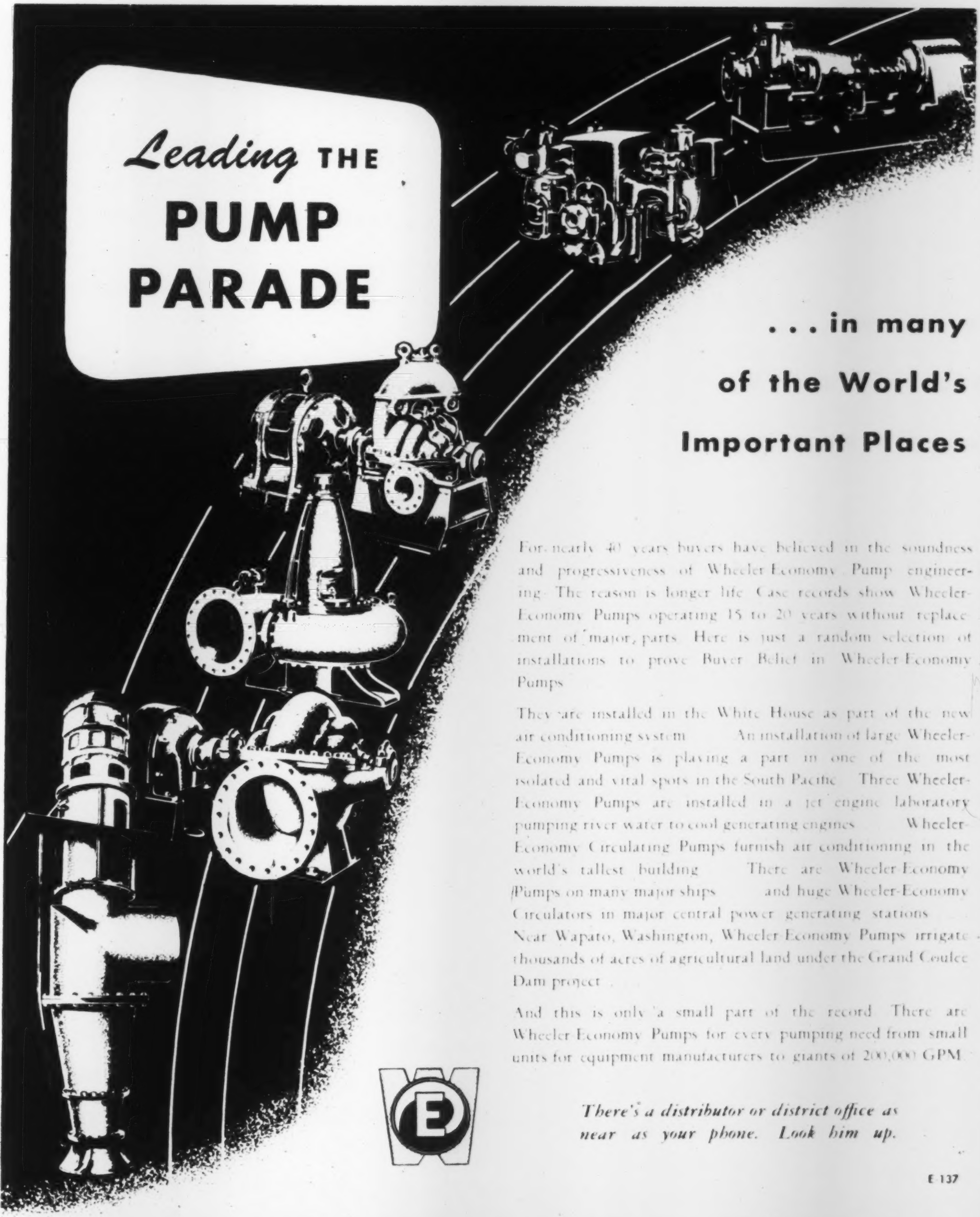
MIAMI BEACH CONVENTION

Casa Blanca Hotel
June 17–19
1953

NEW YORK CONVENTION

Hotel Statler
October 19–23
1953

Members of South Dakota Branch of Northwestern Section meet at Pickstown, S. Dak., for conducted tour of Fort Randall Dam project during which they have opportunity to observe river-closure operation being performed by hydraulic fill. Luncheon and a briefing session, conducted by George O. Evans, area engineer for Corps of Engineers in charge of construction of project, preceded inspection tour. Shown here, in usual order, are E. C. Malmstrom; M. E. Von Seggern, president of Branch; T. W. Johnston, K. R. Marmion, and G. E. Cawelti. Background reveals a portion of the rolled earthfill and the discharge end of the outlets through which the river is being diverted.



Leading THE PUMP PARADE

. . . in many of the World's Important Places

For nearly 40 years buyers have believed in the soundness and progressiveness of Wheeler-Economy Pump engineering. The reason is longer life. Case records show Wheeler-Economy Pumps operating 15 to 20 years without replacement of major parts. Here is just a random selection of installations to prove Buyer Belief in Wheeler-Economy Pumps.

They are installed in the White House as part of the new air conditioning system . . . An installation of large Wheeler-Economy Pumps is playing a part in one of the most isolated and vital spots in the South Pacific. Three Wheeler-Economy Pumps are installed in a jet engine laboratory pumping river water to cool generating engines . . . Wheeler-Economy Circulating Pumps furnish air conditioning in the world's tallest building . . . There are Wheeler-Economy Pumps on many major ships . . . and huge Wheeler-Economy Circulators in major central power generating stations . . . Near Wapato, Washington, Wheeler-Economy Pumps irrigate thousands of acres of agricultural land under the Grand Coulee Dam project . . .

And this is only a small part of the record. There are Wheeler-Economy Pumps for every pumping need from small units for equipment manufacturers to giants of 200,000 GPM.

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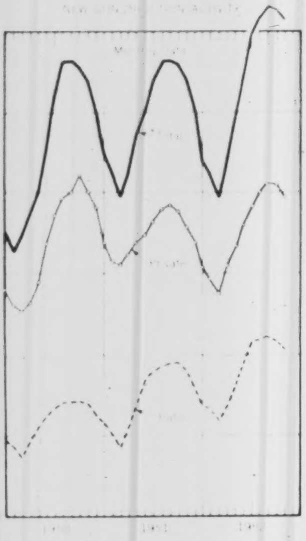
NEWS BRIEFS . . .

Slight Decline Reported in October Construction Activity

Expenditures for new construction in October declined slightly from the September total of $3.1 billion to $3.0 billion, according to preliminary estimates of the U. S. Labor Department's Bureau of Labor Statistics and the Building Materials Division of the U. S. Department of Commerce. The decline was somewhat less than expected for the time of year largely because private building construction held about even with the September dollar volume. October marked the fifth successive month in which total dollar outlay for new construction was 5 percent or more above the monthly total for a year ago.



Slight seasonal decline in construction activity in October from high September level is indicated in Department of Commerce curves

Both private and public construction expenditures declined less than seasonally this October to totals of $1,982 million and $1,025 million, respectively. In the private sector, residential building remained steady at just above the billion-dollar level, and among the various types of non-residential building construction, school, church, commercial and industrial building rose somewhat. Public utility construction declined 5 percent from September largely because of declines in new work in the electric light, power, and gas utility group.

For the first ten months of this year, new construction expenditures totaled $27,025 million, 4 percent above the amount for the same period in 1951. When adjusted for price changes, however, construction activity was at essentially the same level for both years.

Private expenditures for new construction have been exceeding the 1951 monthly level since July, and by the end of October totaled $18,066 million, almost equalling last year's January-October estimate. For the first ten months of 1952, the dollar volume of private residential construction alone was slightly in excess of the entire public total. Public expenditures, totaling $8,959 million, were 16 percent higher this year than last, the increase being largely attributable to more military and naval facilities. Expenditures for public industrial construction were 80 percent higher this year, and for military and naval projects 60 percent higher. However, dollar outlays on the latter are running at significantly lower levels than originally expected because of extensive downward revisions received from the Corps of Engineers.

Expressway Plan Developed for City of Milwaukee

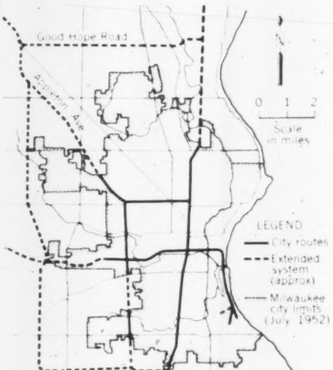
Preliminary plans for a comprehensive expressway system for the City of Milwaukee, Wis., have been made by Ammann & Whitney, consulting engineers of New York, and Nathan Cherniack, M. ASCE, economist and traffic consultant. Authorized to study the city's serious traffic problem and to suggest a solution to it, the engineering consultants base the proposed system of expressways on factors of land use, economics, and a comprehensive city traffic pattern as predicted for the year 1980.

The traffic pattern was developed from a 1944-1945 Origin-Destination Survey made by the U. S. Bureau of Public Roads, the State of Wisconsin, and the City of Milwaukee. This survey, which analyzed the 300,000 daily vehicle trips made in the metropolitan area at that time, has since been brought up to date. New traffic counts indicate that there has been a 100 percent increase in traffic since the survey was made. In the next thirty years, an increase of about 50 percent over today's figures—a total of about 900,000 trips daily—is expected.

The proposed system consists essentially of four parts—two east-west routes, and two north-south routes—as shown on the accompanying map. Totaling almost 24 miles within the city, the routes form an interior cordon of limited-access roads connecting with the principal highways leading into the city. The primary expressway is the east-west route which bounds the downtown area on the south from Lake Michigan to 10th Street, and then follows the abandoned Rapid Transit Company right of way to the west. Another major element is the north-south route which runs from a connection with Highway 41 on the south to link with Highway 141 on the north, passing through the city just west of the downtown area. A third is the 44th Street route, extending from the south city limits near 44th Street to the northwest corner of the city. The fourth is the North Avenue route, providing a northerly connection between the north-south and 44th Street routes.

The east-west and north-south routes will provide direct access from the downtown area to outlying areas and to major state highways. The 44th Street route will act as a connection to the important, rapidly developing areas northwest and southwest of the city. The North Avenue route completes the inner cordon which provides alternate routes for drivers crossing the city diagonally, thereby reducing the pressure of traffic on the main north-south and east-west routes. It will greatly benefit the north side of the city by relieving the present heavily traveled east-west streets.

Four complete interchanges provide for



General location plan of Milwaukee Expressway System that takes into account anticipated traffic growth up to 1980 the flow of traffic between the four routes, permitting through and turning movements to be made directly and continuously without reducing the capacity of the expressway lanes. Simplified as much as practicable, all turning movements are started in the direction the drivers plan to take, thus reducing confusion.

Divided by a 12-ft center mall, the proposed expressway will have a six-lane roadway, three lanes in each direction, with the exception of the 44th Street Expressway, which will have only four lanes. Each of these 12-ft wide lanes has been designed to carry the traffic of three or four normal city street lanes, allowing it to move safely and continuously at 50 mph. Through residential and most commercial areas the recommended expressways are depressed and completely landscaped.

The engineering report estimates the cost of 20.4 miles of the proposed expressway system at approximately $158,000,000 $100,000,000 for construction, and the remainder for real estate. To expedite construction, the report recommends a program of financing "by utilization of current funds and bond issues within the present bonded debt limit supported by a county-wide vehicle or property tax."

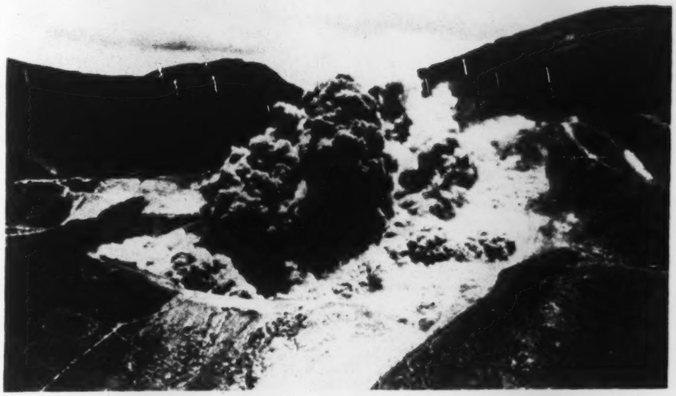
Trucks Start Rolling On WASHO Road Test

Controlled truck traffic was started early in November on a special test road south of Malad, Idaho, in a new research project that will study the relative effects of various axle loadings on different thicknesses of asphalt pavement.

Known as the WASHO Road Test, the research project is sponsored by the highway departments of eleven Western states, with the cooperation of the Bureau of Public Roads, the Automobile Manufacturers' Association, the Truck Trailer Manufacturers' Association, the petroleum industry and others. Administration of the project and the conduct of the research studies have been delegated to the Highway Research Board, which two years ago conducted similar tests on a concrete pavement strip in Maryland.

For the WASHO project, two test loops with 1,900 ft of two-lane straightaways made up of asphalt pavements of different thicknesses were constructed this summer. Truck semi-trailers with tandem-axle loads of 32,000 lb are running in one lane of the southern test loop alongside vehicles with 40,000-lb tandem-axle loads in the adjacent lane. Simultaneously, vehicles with 18,000- and 22,400-lb single-axle loads are running in the two adjacent lanes in the north test loop. The trucks will operate for two nine-hour shifts daily, six days a week, until the pavement freezes. Traffic will be resumed in the spring and continued until each test section has been subjected to about 200,000 applications of the test axles.

Venezuela Speeds Work on Caracas-LaGuaira Highway



Largest explosive blast ever set off on highway construction project lifts and crumbles 390,000 cu yd of rock from Venezuelan mountainside to open deep cut on ten-mile, four-lane highway that is being pushed to completion by Venezuelan government between seaport of LaGuaira and capital city of Caracas. In preparation for blast, three tunnels were driven under mountain. Numerous tunnels were then driven from main tunnels to chambers, which were excavated to hold the explosive charges. In addition, explosives were loaded into vertical holes, drilled from the surface and bottomed between the tunnels. Built at estimated cost of $70,000,000 and called "Autopista," spectacular project will eliminate 300 hairpin curves on old route and reduce driving time to 15 minutes. Section shown here is being constructed by Exploraciones, Voladuras y Drenajes S.A., under contract from the Venezuelan Ministry of Public Works, of which Henriquè Siblesz is engineering director. Information and photo courtesy Gardner-Denver Co., Quincy, Ill.

Contract Award Expands AEC Hanford Program

Completion of negotiations with Kaiser Engineers, a division of the Henry J. Kaiser Company, for construction of the major part of the new expansion program of the Hanford plutonium-producing project is announced by the manager of the Hanford Operations Office of the Atomic Energy Commission. Contracts for designing the new plants have been signed with the Vitro Corporation of America, New York City, and the Charles T. Main Co., of Boston. The General Electric Co., operating contractor of the Hanford works, will furnish basic engineering design for the program.

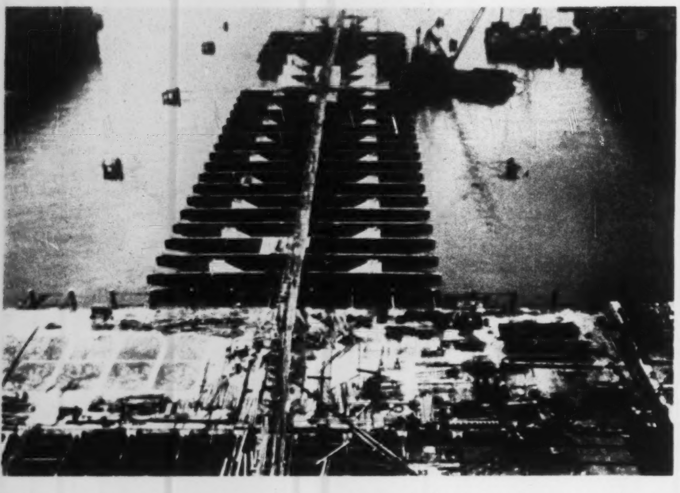
The Kaiser Engineers' phase of the Hanford construction program and other connected work yet to be awarded by the AEC will total approximately $138,000,000, according to George Havas, vice president and general manager of Kaiser Engineers. The present contract comes to about $110,000,000, of which nearly $60,000,000 will go for highly specialized equipment and construction materials. Later there will be several additional prime lump-sum contracts totaling about $28,000,000 for appurtenant work, including an administration building, shops, and chemical storage facilities.

Work will begin in the late autumn. At the peak of construction, which will be reached late in 1953 or in the first half of 1954, the construction force will number about 11,000.

Engineers Named for New Delaware River Bridge

Appointment of the engineering firms of Ammann & Whitney, of New York, and Modjeski & Masters, of Harrisburg, Pa., to act jointly in designing and supervising construction of a new $91,000,000 bridge across the Delaware River is announced by the recently created Delaware River Port Authority. Linking Philadelphia with Gloucester, N.J., the project will require about four years for completion. The authority recently voted to have a seventh lane included in the plans.

Substructure of Pier 57 Nears Completion



Deck girders are poured as third and outermost concrete box of New York's Pier 57 awaits final positioning. First box, parallel to shore (foreground), and second box, perpendicular to shore, have already been seated in final position on river bottom. Buoyancy of boxes will carry about 80 percent of completed pier. Boxes cast at Haverstraw, N.Y., were floated about 30 miles down river without mishap. (See article, "Civil Engineering," March 1952.)

Pennsylvania Begins Work On Turnpike Extension

The first project in the construction of the 33-mile Delaware River Extension of the Pennsylvania Turnpike System will get under way soon, following award of a $1,809,680 low bid contract to George M. Brewster & Son, Inc., of Bogota, N.Y. The initial project calls for the construction of structures and the grading and paving of a 4.72-mile section in Upper Merion Township, Montgomery County.

Bypassing Philadelphia, the Delaware River Extension will link Valley Forge, present eastern terminus of the turnpike, with the Delaware River. Ultimately it will connect with the New Jersey Turnpike by means of a new Delaware River bridge.

Solutions to Highway Problems Are Sought

Engineers are reminded that they can employ their technical know-how to good advantage by taking part in the recently announced General Motors contest for solutions to America's critical highway problem. Prizes totaling $194,000 will be given for the best essays on the subject, "How to Plan and Pay for the Safe and Adequate Highways We Need." A total of 162 state, regional, and national awards will be given for entries that are considered best by an independent board of five judges.

A booklet giving background information about the highway crisis that will be helpful in preparing entries may be obtained from any General Motors dealer or from General Motors Better Highways Awards, General Motors Bldg., Detroit 2, Mich. The contest closes midnight, March 1, 1953.

Hudson River Opposed as Source of N.Y.C. Water

Tentative plans for using the Hudson River as a permanent source of water supply for New York City have been dropped. In a recent letter to Irving V. A. Huie, M. ASCE, president of the New York Board of Water Supply, Mayor Impellitteri asked that body not to proceed further with a previous request to employ outside engineers and consultants to study the Hudson River proposal.

The original recommendation that the Board institute such studies was made last April by the Mayor's Committee on Management Survey, an over-all city government survey group set up under former Mayor O'Dwyer. Since then the Mayor's Board on Management Improvement, a City Hall advisory group, has vetoed the suggestion for studying the use of Hudson River water. The report of the advisory group upheld the contention of the Board of Water Supply that the upper Delaware is the best available source of additional supply.

Further expansion of Delaware River water facilities by development of the Cannonsville project on the west branch has long been under consideration by the Board of Water Supply. The project has been approved by the Board of Estimate and the State Water Power and Control Board.

Applications for Science Foundation Awards Invited

Availability of more than 500 awards for graduate study during the 1953-1954 academic year in the engineering, mathematical, physical, medical, and biological sciences is announced by the National Science Foundation. Fellowships are limited to United States citizens, and selections will be made solely on the basis of ability. The majority of the fellowships will go to graduate students seeking masters' or doctors' degrees in science, although a limited number of awards will be made to post-doctoral applicants.

Applications for the current awards may be obtained from the Fellowship Office, National Research Council, Washington 25, D.C. Completed applications must be returned by January 5.

Rising Electric Power Demand to Continue

A forecast that the electric power shortage will continue well into 1955, and, probably, into 1956 was made by C. R. Beardsley, chief of the Power Requirements Branch of the Defense Electric Power Administration, in an address before a recent meeting of District 2 of the American Institute of Electrical Engineers at Toledo, Ohio. Mr. Beardsley based his prediction on the estimated electric energy required to serve combined civilian and defense needs.

The DEPA energy requirements, he noted, are gross figures based on the assumption that established production goals will be attained; that there will be no significant economic change; that full mobilization will not take place; that government appropriation will be adequate; and that there will be little change in labor supply and hours of work. The effect of possible strikes or other stoppages is also ignored.

Total electric energy requirements, based on commodity and use classifications, are estimated at 487.7 billion kwhr for 1952; 559.7 billion kwhr for 1953; 624 billion kwhr for 1954; and 681.7 kwhr for 1955.

Military Manpower Needs And Resources Reviewed

In response to renewed interest in the military manpower situation arising from General Hershey's announcement that it may be necessary to draft fathers next year to meet the requirements of the Armed Forces, the Engineering Manpower Commission of Engineers Joint Council has prepared a brief review of the military manpower situation.

For the three-year period beginning July 1, 1952, and ending June 30, 1955, the Armed Services will require for expansion and replacement approximately 3,300,000 persons. From the pool of men 18½ to 26* there must be provided about 75 percent of the total requirements of 3,300,000, or about 2,475,000.

On June 30, 1952, Selective Service had a net pool of about 1,100,000 men. Of this number approximately 50 percent, or 550,000, may be assumed to be actually available for military service. The only substantial additions to this pool will be the young men attaining the age of 18.† At the present time this number is about 1,050,000 per annum, of which not more than 600,000 each year, or a total of 1,800,000 for the three-year period, will actually be available for military service, whether by enlistment or induction. The total of 1,800,000 added to the 550,000 now available produces a total supply of 2,350,000 against probable needs of 2,475,000.

According to the EMC, there does not seem to be much doubt that within the period of a year to a year and a half the Selective Service System will have exhausted its reserves and must then look almost entirely to the 18½-year-olds for the filling of calls. All this, of course, will require a reexamination of Selective Service policies and procedures if the requirements of the Armed Forces are to be met, since the 18½-year-olds will obviously not be sufficient in number to meet probable requirements.

While there are about 1,000,000 men deferred for dependency as fathers, this pool would not produce more than 500,000 if all were drafted, and it may be assumed that the whole occupational deferment program will be reexamined before any such drastic action as the drafting of fathers is taken.

At the present time about 194,000 college students are deferred, and it is this program that is bound to feel the impact of any revision of policy. It is assumed that the student-deferment program will continue for the current academic year, September 1952 to June 1953, but that it will be drastically revised thereafter, probably upon the basis of selected areas, such as medicine, dentistry, veterinary medicine, engineering, the physical sciences and other critical areas. Industrial and other business deferments are bound to suffer, too, unless some procedure can be set up for providing Selective Service local boards with more complete and adequate information concerning registrants possessing professional, scientific, engineering, and other skills.

So far as business is concerned, it may be assumed that with the exception of the relatively few skilled persons who may be deferred because of their importance to the civilian economy and defense production, the destiny of the physically fit young man is active military service for a minimum period of 24 months and that those who employ labor must look for it in the pool comprised of veterans, women, under-age and over-age persons and 4-F's.

* The liability of some registrants will be extended to age 35 by reason of deferred status.

† Men must register at 18 but are not liable for induction until 18½.

NPA Releases Materials For 500 New Projects

Controlled materials have been made available by the National Production Authority for the construction of 500 commercial, religious, municipal, and entertainment projects, with an estimated cost of almost $100 million. In addition, construction authorization was given 18 projects that required no accompanying allotments of materials. Delivery of materials will be made toward the end of 1952 and in the first half of 1953.

A breakdown of the allotments indicates that churches lead with 154 projects at an estimated cost of $29,000,000. Retail stores come next, with 77 projects costing $16,000,000. There are 50 recreational and entertainment projects costing about $600,000. A breakdown by states places New York at the top with 44 projects, valued at nearly $14,000,000, California second with 38 projects costing $5,000,000, and Texas third, with 36 projects totaling approximately $6,000,000.

Huge Freight-Car Yard Is Completed at Birmingham, Ala.

Far-reaching effects of recent opening of Southern Railway System's Ernest Norris Yard at Birmingham, Ala.—the most modern freight-car classification yard in the United States and the largest in the South—are reported from all areas of freight-car travel in the country. Project includes a 14-track receiving yard, with two of the tracks to be used as thoroughfares, a 56-track classification yard (shown here); two departure yards of six tracks and a thoroughfare track each; a six-track car repair yard; a 14-track local yard; and a variety of yard towers and buildings, including stock pens, refrigerator car icing facilities, and servicing facilities. In this classification yard, car retarders and automatically-operated switches permit rapid "sorting" of freight cars into 56 different classifications without any reswitching. With facilities for 2,533 cars at one time, the yard can easily handle the 1,250,000 cars that Southern Railway System lines move annually in the Birmingham terminal area.

Water Picture for October

Severe drought conditions are reported for the Southeast and the Southern Mid-Continent area by the U. S. Geological Survey in its summary of water conditions in the United States in October. In some areas of the Southeast, notably Louisiana and Mississippi, river flow was at a 14-year low. Runoff continued deficient in northern Florida, too, though minor floods occurred in the southern part of the state. Water supplies for many North Carolina municipalities were reported critical, with Asheville having only about a week's supply in storage at the end of the month. Other areas of severe drought are Texas and Oklahoma.

In much of the rest of the United States runoff was deficient and groundwater levels were below average during the month. More of the West had below normal runoff than has occurred for a long time. Colorado River flow was only 81 percent of normal, and the flow of the Columbia River at The Dalles barely above normal. Some reduction in power generation was reported in both Washington and Oregon.

Streamflow was also well below normal in most of the Northeast, including New York, Pennsylvania, and New England. However, storage in the reservoirs of the New York City supply system was above average.

New Chief of Army Engineers Appointed

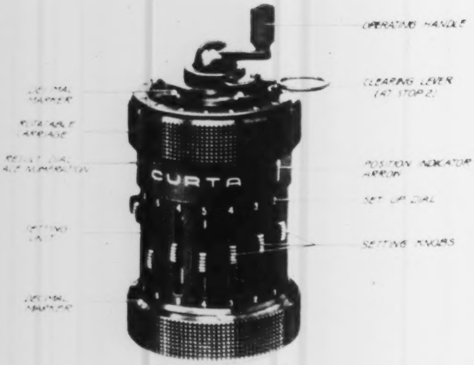
Selection of Maj. Gen. Samuel D. Sturgis, Jr., to be the new Chief of Army Engineers is announced by Secretary of the Army Frank Pace. General Sturgis, who is currently commander of the Communication Zone of the Army in Europe, succeeds Lt. Gen. Lewis A. Pick, M. ASCE, who will retire at the end of November upon reaching the statutory retirement age of 62 (see "News of Engineers" item, this issue).

Since it may be necessary for General Sturgis to remain in Europe some time in order to close out the business of his present command, General Pick will serve as head of the Corps until his return.

Pocket-Size Computing Machine Is Developed

Field parties and job inspectors required to make frequent on-the-spot computations of a high degree of precision will be immeasurably aided by a new pocket-size computing machine of the single step drum type (shown at left and below).

The 8-oz machine, which is called "Curta," can multiply an eight-digit number by a six-digit number and give an eleven-digit answer. Operating like a standard manual office machine, it can add, subtract, multiply, and divide. Additional information about Curta, which is manufactured in Lichtenstein, Europe, can be obtained from Serge A. Emery, 41 Shonnard Ave., Freeport, N. Y.



Nomenclature for Curta, pocket-size computer, shows similarity to standard manually operated office machine (photo at left). In upper view, small size of computer is demonstrated by the way it fits snugly into the left hand. Digits are generally set up by the left hand, leaving the right hand free to turn the operating handle.

River Development Planned for Poland

Completion of extensive plans for river development in Poland is announced by the Polish Embassy in Washington. The program calls for flood prevention for an area of more than 1,700,000 acres, the building of hydroelectric power stations with an annual output of 2,000,000,000 kwhr, and construction of irrigation and drainage systems and a modern network of waterways to link commercial and industrial centers.

The initial project in the river development program will be improvement of the Vistula, which will be made navigable for its entire 621-mile length for vessels up to 1,000 tons. At present only a 124-mile stretch is open to large vessels. To be undertaken in stages, the Vistula improvement project includes construction of hydroelectric stations in the upper river, the creation of artificial lakes in the area near the mouth of the San River, and the building of reservoirs for flood control and power generation on the main tributaries in the Carpathians. The Bug River will be developed for generation of 400,000,000 kwhr annually. The principal canal construction project will connect the Vistula and the Odra rivers, making it possible for the Vistula to carry heavy cargoes to and from the rich Silesian basin.

At present less than half of the country's 3,000 miles of navigable rivers and canals is open to shipping, and only a small percentage of its annual potential of 10,000,000,000 kwhr from river sources is being used. Estimates place the economic benefits to be realized from the projected river development at more than $125,000,000 annually.

Aluminum Output Gains Despite Power Shortages

Although power shortages cut the production of primary aluminum by more than 16,000,000 lb in September, as compared with August, the third quarter's output exceeded that of the preceding quarter by 2.2 percent, according to an announcement from Donald M. White, secretary of the Aluminum Association. "The increase resulted from the new facilities which went into operation for the first time during the quarter," Mr. White explained. "The 480,850,855-lb quarterly output represented a gain of 11.3 percent over the same quarter in 1951 when the total production was 431,883,793 lb," he added.

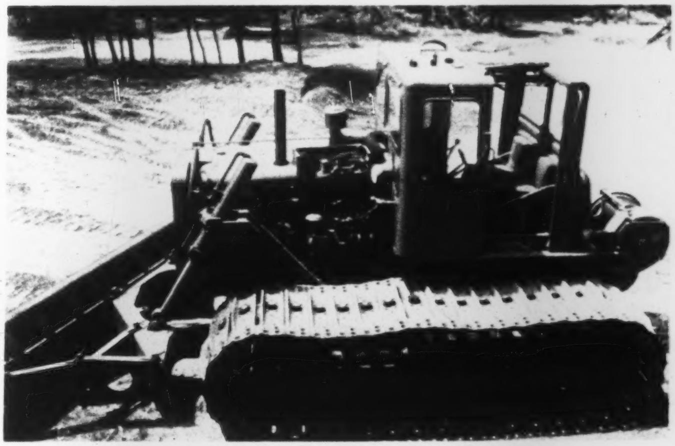
Primary production during September was 153,764,606 lb, an increase of 18 percent over the same month in 1951, when only 138,857,530 lb were produced. "The difference in these totals is significant," Mr. White pointed out, "when we consider that power shortages also existed in September 1951 but were not as serious as current conditions that are hampering normal output."

Joint Group Will Study Municipal Construction

To facilitate study of municipal construction matters of mutual interest to general contractors and public works officials, the American Public Works Association and the Associated General Contractors of America have established a national joint committee that will consider questions submitted to it by representatives of both interests. The committee was set up at the suggestion of AGC President Arthur S. Horner, A.M. ASCE, of Denver.

Committee co-chairmen are George R. Thompson, M. ASCE, city engineer of Detroit, for the APWA, and C. R. Ralph, of the Kaw Paving Co., Topeka, Kans., for the AGC.

Army Develops Special Tractor for Arctic Use



To meet special problems posed in Arctic operation of construction machinery, Engineer Research and Development Laboratories at Fort Belvoir, Va., have developed this experimental model construction tractor. Unit is provided with wide tracks, dozer with inside-type push arms to narrow overall width, and cab with heater and spring-loaded, quick-opening doors to permit speedy egress in case unit crashes through ice. Electric starter has been replaced with starting engine since standard batteries lose their power at low temperatures and engines require extensive cranking. Heating and insulating equipment for engine is also incorporated.

Annual Meeting of AAAS To Mark Two Centennials

The 119th annual meeting of the American Association for the Advancement of Science—to be held in St. Louis, Mo., December 26-31—will be part of Washington University's Centenary as well as the final event of the Centennial of Engineering. A wide attendance from the Midwest area, representing educational institutions, research laboratories, and industry, is expected at the meeting, which will be devoted to the general theme, "The Contributions of Science and Mathematics to Engineering and Industry." There will be two principal symposiums of several sessions each—one on "The Nation's Nutrition—from Soil to Cytoplasm," and the other on "Disaster Recovery," covering floods, earthquakes, industrial disasters, and atomic blasts and all phases of recovery.

Headquarters for the AAAS annual Exposition of Science and Industry will be the Kiel Auditorium in St. Louis, which will also be the main information and registration center. Other sessions will be held at Washington University and the Jefferson and other hotels.

Courses in Radiological Health Will Be Given

A series of three two-week courses in Radiological Health Protection, including technical laboratory procedures, will be presented in Cincinnati, Ohio, commencing January 19. The program, which is offered free to qualified applicants by the Public Health Service at its Environmental Health Center, has the objective of assisting health department employees and key personnel in other governmental and private organizations to achieve a working knowledge of hazards and problems related to use of X-rays, radioelements, neutron fluxes, and particle accelerators.

Inquiries should be addressed to the Chief, Radiological Health Training Section, Environmental Health Center, 1014 Broadway, Cincinnati 2, Ohio.

Atomic Research Center To Be Built in Europe

Thirty nuclear physicists from ten European countries met in Amsterdam, Holland, early in October to select a site for a great European nuclear research laboratory. A location near Geneva, Switzerland, was the unanimous choice of the group, representing member nations of the European Council for Atomic Research—an organization founded recently with the help of UNESCO.

To be used exclusively for pure scientific research, the laboratory will house what may be the most powerful atom-smashing cosmotron in the world—a huge accelerator that will be rated at 30,000 million electron volts. There will also be a synchro-cyclotron, with a rating of 600 million electron volts. About seven years will be required for building and equipping the laboratory, and the annual total cost to the participating countries will be about $4,000,000. Results of the research will be supplied freely to all member nations of the European Council for Atomic Research.

Alaska Pushes Defense Construction Program

For the convenience of contractors interested in bidding on Alaska defense construction projects, a Prospectus of Construction listing many types of construction to be erected during 1953, under a program approximating $250,000,000, has been made available by the Alaska District of the Corps of Engineers. Alaska defense construction contracts are awarded by the Alaska District Engineer on the basis of open competitive bidding, with any contractor invited to bid. There are 112 proposed construction projects scheduled under the 1953 program, and a number of additional projects are carried over from earlier programs. It is hoped to have the bulk of the funds under contract by April 1953.

Requests for the construction booklet containing late information on types of contracts, transportation facts, facilities for contractors, weather, labor, and construction under way—should be addressed to the Seattle office of the Alaska District Engineer, 300 Exchange Bldg., or to its Anchorage, Alaska, headquarters.

New Welding Contest Open to Undergraduates

Rules and conditions governing the sixth annual competition of the Lincoln Arc Welding Foundation's Engineering Undergraduate Award Program have now been released. The 46 awards, totaling $6,750, will be made for the best designs of a machine, machine component, structure, or structural part designed for welded construction. Duplicate awards will be made for the best entries in both mechanical and structural design. In addition, there will be three grand awards for the best of the program designs. In order not to interfere with normal school curricula, entries will be limited to twenty pages, and undergraduates will be permitted to complete their program entries after graduation.

A rules and conditions booklet, giving suggestions for subject matter, a bibliography, and previous award titles illustrated with drawings, is available from the Lincoln Foundation, Cleveland 17, Ohio.

AGC Nominates New Officers for 1953

The nomination of C. P. Street, secretary and manager of McDevitt & Street Co., of Charlotte, N.C., for 1953 president of the Associated General Contractors of America is announced by the Association. Mr. Street is currently serving as vice president. John MacLeod, president of the Macco Corp., of Paramount, Calif., was nominated for vice president. Voting will be by letter ballot, and the new officers will be installed at the conclusion of the AGC annual convention in Miami, Fla., in March.

ACI Officers Announced

Henry L. Kennedy, M. ASCE, manager of the Cement Division of the Dewey & Almy Chemical Co., Cambridge, Mass., has been nominated for a one-year term as president of the American Concrete Institute. Charles S. Whitney, M. ASCE, member of the New York consulting firm of Ammann & Whitney, will begin a two-year term as vice president, and C. H. Scholer, M. ASCE, head of the department of applied mechanics at Kansas State College, will complete the second year of a two-year term to which he was elected last year. New directors, nominated for a three-year term, are Federico Barona de la O, Arthur P. Clark, A.M. ASCE, Ivy E. Jellick, and Vernon P. Jensen, M. ASCE.

Installation of the new officers will take place at the February 1953 convention of the ACI, to be held in Boston.

Contract Awarded for Thruway Bridge Piers

Award to the Merritt-Chapman & Scott Corp., New York building firm, of a $11,772,529 low bid contract for fifteen deep-water pier foundations, including ten of buoyant design, for the Thruway Bridge across the Hudson River between South Nyack and Tarrytown is announced by Bertram D. Tallamy, A.M. ASCE, chairman of the New York State Thruway Authority.

Construction of the special foundations will involve use of ten giant watertight boxes of reinforced concrete, half the size of the city block, to provide a buoyant pier base resting on the silty river bottom. With solid rock too far below the surface at some points for effective and economical pier support, the air-filled caisson design was evolved to solve the problem. Two of the foundation boxes will be 184 ft long, 100 ft wide, and 40 ft high, and will weigh approximately 18,400 tons. Two will be 120 ft long, 60 ft wide, and 40 ft high, and the other six will be the same height but slightly smaller. In constructing the boxes, the contractor will follow much the same procedure recently used in building the substructure sections for the city's Pier 57.

N. G. Neare's COLUMN

R. Robinson Rowe, M. ASCE

"Our whimsical fiction of harmonization of train whistles by governing passing speeds at Toonerville has provoked some interesting repercussions," announced Professor Neare. "One of the repercussers denies that locomotives tweet or woof; he says they toot. Another, quite indignantly, demands that reform begin with the solo whistle, converting its strident diminished minor triad to some euphonious interval.

"However, persisting in our whimsy that whistles are monotonic and that two different ones on passing trains can harmonize in perfect fourths and fifths, major thirds and minor sixths, can you tell us, Joe, the speed of the faster train?"

"I can't even guess, Professor," confessed Joe Kerr. "I learned about the Doppler effect in Tech, but you have to go to a conservatory to learn about musical fractions. My sister Fay did, and she tells me a third plus a fifth is a seventh. Silly, isn't it?"

"Joe has a point there," agreed Cal Klater, "but those musical 'fractions' are really intervals, expressible also as the pitch ratio of two notes. Ratios for the four given intervals are 3:2, 4:3, 5:4 and 8:5, that is, the apparent pitches of approaching and retreating whistles, expressed in vibrations per second reaching a Toonerite ear, must be related by these four ratios.

"I found it convenient to express speeds in machs, x being the speed of the Tweeter Limited, y the speed of the Woofer Express, and unity the speed of sound. Then, if m and n are pitches of whistles when stationary, their apparent pitch when approaching will be $m/(1 - x)$ and $n/(1 - y)$ respectively, and the apparent interval will be a perfect fifth if these apparent pitches have the ratio 3:2, or if

$$3n(1 - x) = 2m(1 - y) \qquad (1)$$

The other ratios can be represented in the same way for combinations of approaching and retreating trains:

$$4n(1 + x) = 3m(1 + y) \qquad (2)$$

$$5n(1 + x) = 4m(1 - y) \qquad (3)$$

$$8n(1 - x) = 5m(1 + y) \qquad (4)$$

"Now if we double Eq. 1 and subtract 3 from it, we find directly that $x = {}^1/_{11}$ without using the other two equations. So my answer is that the Tweeter runs one-eleventh as fast as sound."

"A good way to leave it, Cal, as the engineman would have to vary speed with temperature. In mph at 42°F, sound travels at 750.2, which is divisible by 11 and 31, so $x = 68.2$ and $y = 24.2$ mph.

"These answers being in exact tenths instead of integers remind me of the rabbit corral at the zoo, laid out in the shape of a right triangle. When the rabbits multiplied, the cage was enlarged by adding 5 ft to each leg and 6 ft to the hypotenuse. The original dimensions might have been 4.8, 28.6 and 29 ft respectively, except that all three were integers. Joe, will you find me the dimensions for a small cage for cottontails, and Cal, a larger one for jacks?"

[Cal Klaters were: Stoop (John L.) Nagle, A. Nuther Nutt, Richard Jenney, Fred W. Morrill, T. J. Ogburn III, and Marvin (Sauer Doe) Larson. Also acknowledged is a flood-routing solution of the September two-tank problem from David M. Rockwood.]

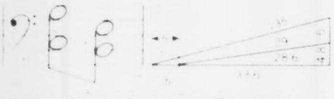


Fig. 1. Tuneful Toots (*a*) at Toonerville and wrong answer (*b*) to new problem.

DECEASED

Edward Flad, Veteran Society Member, Dies

Edward Flad

Edward Flad (M. '88) retired engineer of St. Louis, Mo., and former ASCE Director (1911) died on October 13, at the age of 92. Joining the Society as a Junior in 1885, Mr. Flad was the oldest member of ASCE in point of affiliation. A graduate of Washington University, he entered private practice in 1889 as a member of the St. Louis consulting firm, Johnson & Flad. During his long career, Mr. Flad held such public appointments as water commissioner and member of the Board of Public Improvements for the City of St. Louis (1899-1903), member of the Public Service Commission, State of Missouri (1917-1921), and member of the Mississippi River Commission (1924-1948). He maintained his consulting practice in the periods between public appointments and from 1921 until his recent retirement.

Alexander Joseph Berea (A.M. '29) since 1944 office engineer with George L. Glover Co., Inc., New Orleans, La., died on September 27, at the age of 54. Mr. Berea had been employed as an estimator by several New Orleans firms including the Doullut & Williams Co., the Rouprich Construction Co., and the W. Horace Williams Co., Inc., and had also engaged in private practice in New Orleans for several years. He was an alumnus of Tulane University.

George Ray Boyd (M. '20) who retired on June 30 as an engineer in the U.S. Department of Agriculture, died at his home in Silver Spring, Md., on September 16. He was 69. Mr. Boyd entered the Department in 1908 and during 44 years of continuous service filled many responsible assignments. He had been assistant chief of the former Bureau of Agricultural Engineering and for many years was head of the division of mechanical processing of farm products in the Bureau of Plant Industry, Soils and Agricultural Engineering. Mr. Boyd was a graduate of Iowa State College and a veteran of World War I.

Roy McGarvey Buck (M. '42) captain in the Corps of Engineers, died at his home in Boise, Idaho, on September 21, at the age of 64. In government service for many years, Captain Buck had participated in land and cadastral surveys in Manila, and had been with the U.S. Geological Survey at Boise, and the Bureau of Highways at Coeur d'Alene, Idaho. He had also been employed by several private business organizations including the Washington Water Power Co., and the Colonial Building Co., Spokane, Wash. He was a veteran of both world wars.

Edward Burr (M. '91) brigadier general, U.S. Army (retired) of Washington, D.C., died at the Walter Reed Hospital in that city, on April 15. The 93-year old general was one of the oldest members of the Society in point of affiliation, being thirteenth on the list of veteran members. A graduate of the U.S. Military Academy in 1882, General Burr rose to the rank of brigadier general by the time of his retirement in 1923. He had been stationed in the Philippines, France, and the United States, and had held special assignments such as assistant to the Chief of Engineers, assistant to the Engineer Commissioner at Washington, D.C., and a member of the Joint Army and Navy Board on Panama Canal Defenses.

Richard Davenport Chase (A.M. '00) consulting engineer of New Bedford, Mass., died in that city on October 18, at the age of 82. A specialist in the design and construction of filter plants and water supplies, Mr. Chase was associated at various times with Allen Hazen, consulting engineer of New York, the National Board of Fire Underwriters, and the Air Nitrates Corp. He was connected with the installation of the water supply at Fort Dix, N.J., during World War I, filter studies for the Boston water supply, and construction of the Cobble Mountain, Calaveros and San Pablo dams. Mr. Chase was graduated from the Massachusetts Institute of Technology in 1892.

Leo Francis Crowley (A.M. '32) who was recently promoted from senior associate civil engineer to engineer of surveys in the City Engineer's Office, Detroit, Mich., after 35 years of service, died on August 24. He was 56. Mr. Crowley had attended the University of Detroit. A lieutenant commander in the Navy Civil Engineer Corps, Mr. Crowley served with the 81st Construction Battalion in the European Theater in the recent war. In 1950 he was national president of the Seabee Veterans of America.

Richard William Denner (J.M. '51) of Enid, Okla., was killed in Korea on August 15, while serving as a lieutenant, in the Corps of Engineers. He was 23 years old. Lieutenant Denner graduated from the University of Oklahoma with the bachelor of science degree in June 1951, and then entered the armed forces. He was the winner of an Oklahoma Section prize of Junior membership in the Society.

Andrew Jackson McKenzie (M. '23) founder of the McKenzie Construction Co., San Antonio, Tex., died at his home in that city on October 1, at the age of 69. After receiving a degree in civil engineering from the University of Missouri, he worked briefly for the Frisco Railroad, and served as assistant city engineer, city engineer, and street commissioner for Joplin, Mo. He was president of the McKenzie Construction Co., from the time of its establishment in 1912 until 1948, when his son succeeded him. Mr. McKenzie was a past-president of the Texas Section, and first president of the Texas branch of the Associated General Contractors.

Lewis Gladstone Hooper (M. '22) since 1933 partner in the firm of Swanson, McGraw, Hooper, of New Orleans, La., died in that city on October 21. He was 70. From 1902, the year of his graduation from Tulane University, until 1920, Mr. Hooper held numerous positions in New Orleans and the Canal Zone, as a draftsman and mechanical engineer. He was vice president of the L. H. Guerin Engineering Corp., for five years, and a partner in the firm of Henry & Hooper for seven years before organizing his own firm.

Wilfred Jupenlaz (M. '46) civil engineer with John W. Cunningham & Associates, Portland, Ore., since his release from the Navy in 1945, died on August 8, at the age of 54. A veteran of both world wars, Mr. Jupenlaz served in the U.S. Army from 1917 to 1919, and in the Civil Engineer Corps of the U.S. Naval Reserve, from 1942 to 1945. For almost twenty years he was associated with Morris Knowles, Inc., of Pittsburgh, Pa., as engineer on investigation, design and supervision of water supply, sewerage and city planning projects. Mr. Jupenlaz was a graduate of Pennsylvania State College, class of 1921.

Stanford McGraw Pitts (A.M. '37) since 1935 civil engineer with the Brazos River Conservation & Reclamation District at Minerals Well, Tex., died on September 15, at the age of 49. Mr. Pitts was employed by the Southern Pacific Railroad at Houston for 11 years, advancing from rodman to estimator draftsman. Later he was connected with several government agencies including the U.S. Geodetic Survey, the U.S. Forest Service, and the U.S. Public Health Service. Mr. Pitts had studied at the University of Texas.

Donald Gunn

Donald Gunn (A.M. '41) vice president of the Pennsylvania Water & Power Co. and assistant advisory engineer of the Safe Harbor Water Power Corp., Baltimore, Md., died suddenly at his home there on October 22. He would have been 50 on December 3. Following his graduation from the Georgia School of Technology in 1925, Mr. Gunn joined the staff of the Byllesby Engineering and Management Corp. in Pittsburgh, and later was employed by the Duquesne Light Co. He became connected with the Safe Harbor Water Power Corp. as budget engineer in 1930. He received successive promotions, becoming vice president and chief engineer of the Pennsylvania Water & Power Co., sister company of the Safe Harbor Corp., in 1947.

(*Continued on page 84*)

Deceased

(Continued from page [illegible])

Former Director, Edwin J. Fort, Dies

Edwin John Fort (M. '04) retired engineer of Huntington, N.Y., died sometime in 1946, although news of his death has just been received by the Society. He was 82. A graduate of Cornell University, Mr. Fort was city manager for Niagara Falls, executive engineer of Ridgewood, N.J., and general supervisor for the city of Englewood, N.J. From 1911 until his retirement from civic service, he was connected with the Brooklyn (N.Y.) Department of Sanitation. Active in Society affairs, Mr. Fort was a Director from 1918 until 1920.

Johnson Clemmons Lindsay (M. '23) petroleum engineer with the Western Gulf Oil Co., at Los Angeles, Calif., died in Beverly Hills on September 5. The 68-year-old engineer was a graduate of the University of California at Berkeley. He had been engaged by several Western railroad and oil companies, and performed survey work at various times for the cities of Santa Barbara and Los Angeles.

Alexander Sydney Lynch (M. '19) vice-president of Pavements, Inc., of North Haven, Conn., died on May 28, at the age of 67. For several years Mr. Lynch was chief engineer for the firm of Palmer & Lynch at West Haven, Conn., and he had previously been with the New Haven & Hartford Railroad and the Corps of Engineers. Mr. Lynch was an alumnus of the Sheffield School of Science of Yale University.

John Joseph Murphy (A.M. '26) civil engineer with the Department of Borough Works, Office of the Borough President, Manhattan, New York, N.Y., died on August 12, at the age of 53. A member of the Manhattan department of public works continuously since 1909, Mr. Murphy held the positions of assistant engineer and civil engineer at various periods. He was an alumnus of Manhattan College.

John Robert Nichols (M. '18) for the past 11 years partner in the consulting firm of John R. Nichols and Paul W. Norton, Boston, Mass., died on September 29, while traveling in Italy. He was 69. An alumnus of Harvard College, Mr. Nichols spent several years on the faculty of their graduate school of engineering. For ten years he was associated with Monks & Johnson, Boston, advancing from designer to chief engineer. He then spent a brief period as building manager for W. H. Ballard Co., of Boston. From 1927 until 1941, Mr. Nichols maintained a private practice as a consulting structural engineer.

Royal Upson St. John (A.M. '20) lieutenant colonel, Army Air Force, Oakland, Calif., died there on July 31, at the age of 63. Interested in aviation, Colonel St. John was a pilot in World War I and served as a major in the Army Air Force during World War II, receiving the Bronze Star Medal. He was with the Standard Oil Co. for almost 17 years, as engineer at San Francisco from 1913 to 1918 and district engineer at Sacramento from 1919 to 1930. He was then in charge of construction of the San Francisco Airdrome, and later became its manager. A charter member of the Sacramento Section, Colonel St. John served as Section vice-president in 1926 and 1927.

Walter Rowland (M. '16) retired engineer, died at his home in Petersburg, Va., on September 25, at the age of 82. Civil engineer for the nitrogen division of the Solvay Process Co. (Allied Chemical and Dye Co.) at Syracuse, N.Y., and Hopewell, Va., for 22 years, until his retirement in 1947, Mr. Rowland was instrumental in the design of the company's atmospheric nitrogen plant at Hopewell. From 1907 to 1916 he was engineer in charge of designs for the Pacific piers of the Panama Canal, and was associated briefly with the Foundation Co., Lima, Peru.

Richard Carl Gnaedinger (J.M. '52) of Oak Park, Ill., was killed in an automobile accident near St. Joseph, Mo., on October 17. He was 24 years old. A recent graduate of Northwestern University, Mr. Gnaedinger had also attended Cornell University. While at school, he was employed as a cooperative student by the Soil Testing Services, Inc., of Chicago, Ill., and entered the firm upon graduation. Since June he had been general manager of the boring and testing division. Mr. Gnaedinger was one of the young men who took an active part in plans for the recent Centennial Convocation in Chicago.

R. C. Gnaedinger

Ettore Scimemi (M. '48) professor of hydraulics and director of the Institute of Hydraulics at the University of Padua, Padua, Italy, died on September 11, at the age of 57. A civil engineering graduate of the University of Palermo, class of 1918, Professor Scimemi had spent his entire career on the engineering faculty of the University of Padua. He was author of 50 publications on various phases of hydraulics, and a member of the Venetian Center of Hydraulic Research.

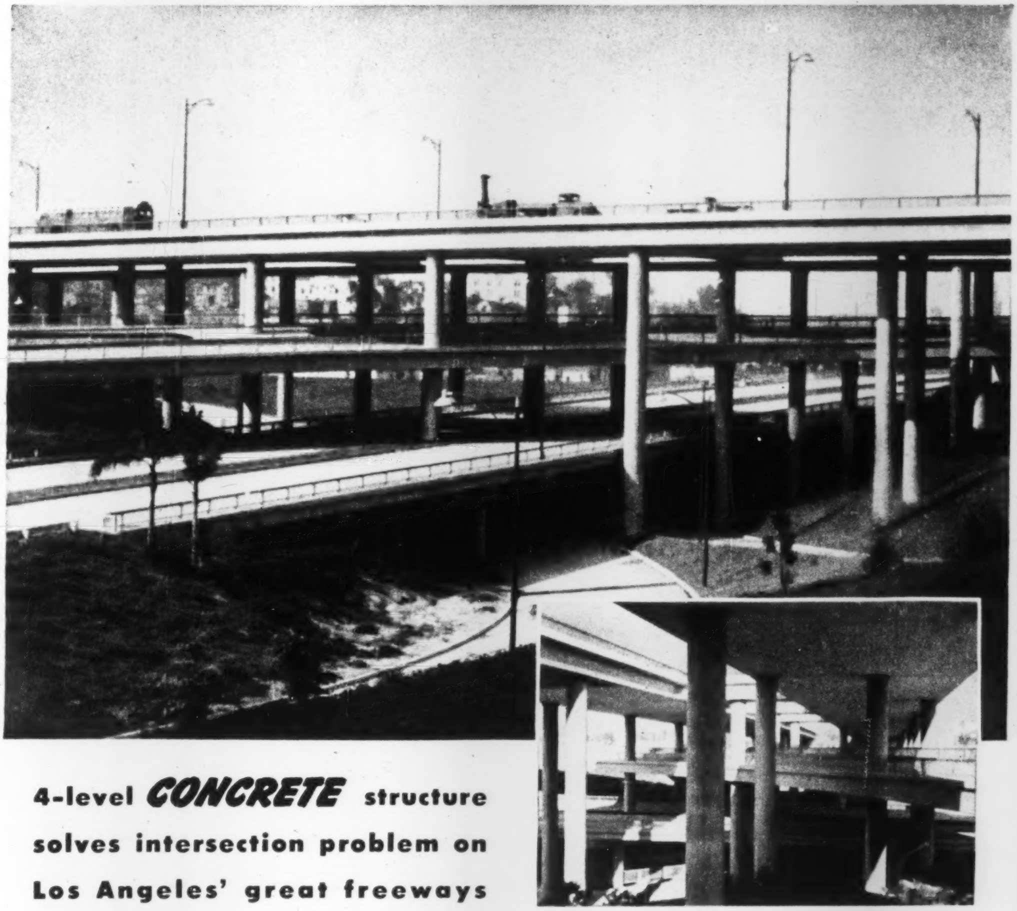
Horatio Seymour (M. '21) retired engineer of Santa Monica, Calif., died on September 7, at the age of 69. Mr. Seymour had acted as engineering consultant to the City of Santa Monica, and was a member of the Board of Directors and cost engineer for the Metropolitan Water District of Southern California. A veteran of World War I, he had worked for the New York Board of Water Supply on the Catskill Aqueduct, and the Public Service Commission on construction of the New York subways. More recently Mr. Seymour was employed as an engineer at the U.S. Naval Destroyer Base at San Diego, and as supervising engineer for the Defense Plant Corporation at Los Angeles. He was a graduate of Yale University.

Minott Augur Osborn Stilson (Aff. '08) for almost 25 years estimating engineer with the Bridgeport Metal Goods Manufacturing Co., of Bridgeport, Conn., died on September 18, at the age of 74. Mr. Stilson had been employed by several companies in Waterbury, Conn., including the J. J. O'Brien Contracting Co., the Young Construction and Contracting Co., and the American Brass Co. At various other periods he worked for the Pennsylvania and New Haven railroads, and the Bridgeport Brass Co., and the Columbia Graphophone Co., of Bridgeport, Conn.

Edgar Stanislaus von Piontkowski (M. '11) retired engineer of Los Angeles, Calif., died in March 1952. He was 80. Engaged on railroad work in the United States, Mexico, Cuba, and the Philippines, Mr. von Piontkowski was with the Manila Railroad Co. from 1906 to 1923, advancing to chief engineer. Upon his return to California, he entered the construction field, and was president of the L. H. Pickens Building Co., in Beverly Hills, until his retirement in 1948.

Kenneth Hammet Talbot (A.M. '19) chief engineer of the Arizona Testing Laboratories, Phoenix, Ariz., died in Phoenix on September 22. He was 65. An authority on concrete, Mr. Talbot was winner of the 1943 Wason Medal of the American Concrete Institute for developing improved methods for underwater placement of concrete in the construction of Navy drydocks. In 1944 and 1945 he directed the concrete installations for the atomic energy plant then being built at Hanford, Wash. He had been concrete engineer for the Bureau of Reclamation, and consultant to the Navy Bureau of Yards and Docks. He first went to Arizona in 1937 while engaged on the construction of Parker Dam. At the time of his death he was owner of the Superior Perlite Co. and secretary of the Central Arizona Concrete Association. Mr. Talbot was a graduate of the University of Illinois and a veteran of World War I.

Edwin Frederick Wendt (M. '03) consulting engineer of Pittsburgh, Pa., died on September 30, at the age of 83. A graduate of Geneva College (Pennsylvania), Mr. Wendt began his engineering work in 1888 on the Pittsburgh & Lake Erie Railroad of the New York Central Lines, rising from rodman to assistant chief engineer. He then served for eight years as a member of the Engineering Board of the Bureau of Valuation, Interstate Commerce Commission, and as chief engineer of the Eastern District in charge of federal valuation of railroads. Mr. Wendt was a former president of the American Railway Engineering Association and the Institute of Consulting Engineers.



4-level *CONCRETE* structure solves intersection problem on Los Angeles' great freeways

The California State Division of Highways faced a knotty problem in providing for uninterrupted traffic flow where the Hollywood, Santa Ana, Arroyo Seco and Harbor Freeways meet in Los Angeles.

To solve this problem engineers designed and built the world's first four-level grade separation—and chose concrete for the job.

The first level of this structure is concrete pavement on ground level. The second is a 415-ft. continuous slab, without expansion joints, supported on reinforced concrete columns and caps. The third and fourth levels are box-girder construction also supported on reinforced concrete columns and caps.

This unprecedented four-level grade separation required less right-of-way. It has great strength and durability and is impressive in its clean-cut appearance. It is an example of the unusual flexibility in design afforded by concrete construction.

Concrete construction is moderate in first cost, requires little maintenance and gives long years of service. The result is true ***low annual cost.***

Additional information on concrete structures for modern highways is available in two publications, "*Continuous Concrete Bridges*" and "*Continuous Hollow Girder Concrete Bridges*." Both are free but distributed only in U. S. and Canada.

PORTLAND CEMENT ASSOCIATION

DEPT. 12-13, 33 WEST GRAND AVENUE, CHICAGO 10, ILLINOIS

A national organization to improve and extend the uses of portland cement and concrete through scientific research and engineering field work

NEWS OF ENGINEERS

Lewis A. Pick, Lt. Gen., U.S. Army, and Chief of Army Engineers, retired on November 30 after an army career of 35 years and three and a half years as Chief of Engineers. General Pick saw service in both world wars, and in World War II supervised construction of "Pick's Pike," the famous military road from India to China across Burma. He is co-author of the Pick-Sloan Plan for developing the water resources of the Missouri River basin.

General Pick

Joseph Anton was recently promoted from lieutenant to lieutenant commander in the U.S. Naval Reserve, the new rank to be retroactive to March 1, 1952. He has the new assignment of Bureau of Yards and Docks technical adviser to the Supervising Inspector of Naval Material, San Francisco, in connection with the inspection of BuDocks construction and transportation equipment.

Jack Y. Barnes, formerly field engineer for the Portland Cement Association's Des Moines, Iowa, office, has been appointed district engineer in charge of its newly opened district office at Helena, Mont. Mr. Barnes has been with the Portland Cement Association since 1947.

Robert B. Brooks, consulting engineer of St. Louis, Mo., and former Vice President of ASCE, was official representative of the Department of State to the Pan American Highway Congress held in Mexico City the latter part of October.

William P. Hughes, until recently city engineer of Lewiston, Idaho, has accepted the position of urban engineer for the Idaho State Highway Department, with headquarters at Boise, Idaho.

Orland Buckius has been appointed building inspector for the City of Stockton, Calif. He was formerly senior civil engineer for Sacramento.

E. Sherman Chase, member of the Boston firm of Metcalf & Eddy, has been elected president of the Federation of Sewage and Industrial Wastes Associations.

Ray H. Corey, consulting engineer of Portland, Ore., announces that he is retiring from active practice and that the local engineering firm of Clark & Groff is taking over his practice. Mr. Corey has maintained offices in Portland since 1930, specializing in recent years in the field of municipal water and sewage works.

Frederick L. Geis, Jr., retired on November 1 as resident engineer for the Corps of Engineers on Folsom Dam, Folsom, Calif., after 34 years in the Corps. Projects on which he has been engaged include four navigation dams on the Kanawha River, the third Panama Canal locks, five navigation locks on the Ohio River, and various navigation aids and general river and harbor works. He expects to go into private business soon. At present his address is 1919 47th St., Sacramento 19, Calif.

Hans H. Bleich has been promoted from associate professor of civil engineering at Columbia University to the rank of professor of civil engineering. In addition to giving graduate courses in structural analysis and design, Professor Bleich is engaged in research in the fields of structures and applied mechanics.

Irving Grossman, until recently sanitary engineer for the New York State Health Department at Rochester, N.Y., is now in the District Health Office at Johnstown, N.Y.

Henry W. Hemple recently retired as chief of the Division of Geodesy of the U.S. Coast & Geodetic Survey, Washington, D.C., after more than 35 years of service. Under his seven years as chief, the Division of Geodesy won international recognition for its work, which included completion of the two largest triangulation adjustments ever undertaken by the Coast & Geodetic Survey. Recently Captain Hemple was awarded the 1952 Department of Commerce gold medal for his services.

Leonard A. Carlson, chief of the Reports and Planning Branch of the Rock Island, Ill., District of the Corps of Engineers, has been given a leave of absence from that office to serve briefly with the United Nations Technical Assistance staff. Mr. Carlson has been assigned to Jamaica where he will study flood control and related water use problems.

William H. Holmes has resigned as principal engineer on the design and construction of dams for the California Division of Water Resources at Sacramento, in order to enter private engineering practice in that city.

Sidney F. Borg, of Levittown, N.Y., has been appointed associate professor of civil engineering at Stevens Institute of Technology, Hoboken, N.J., where he will act as head of the department. During the past year, Professor Borg has been engaged in theoretical research for the Grumman Aircraft Engineering Corp., at Bethpage, N.Y. Previously he taught at the United States Naval Postgraduate School at Annapolis and the University of Maryland. At present he is completing a thesis for the doctor of engineering degree at Johns Hopkins University.

Sidney F. Borg

Edmond H. Leavey, major general, U.S. Army (retired), has been elected a vice-president of the International Telephone and Telegraph Corp., New York, N.Y. An army officer since 1917, General Leavey has had extensive experience in both the operational and administrative fields of engineering. Prior to his retirement this year, he was chief of the Logistics Division of Supreme Headquarters of the Allied Powers in Europe (SHAPE).

General Leavey

Kenneth A. MacKichen and **Orville D. Mussey,** hydraulic engineers for the Water Resources Division of the U.S. Geological Survey, at Washington, D.C., and Charlottesville, Va., respectively, have been appointed to the Survey's new Water Utilization Section. The Section was recently established as a technical staff organization to direct studies and reports on the water resources of designated areas.

Donald P. Lessig, a veteran of 18 months' service in Korea and a graduate student in civil engineering at Carnegie Institute of Technology, is the first recipient of a new research fellowship in civil engineering established this year at Carnegie by the Rust Engineering Co. The new fellowship provides a grant of $3,300 for the academic year for fundamental research in civil engineering. Mr. Lessig's project, which is entitled "Pressure Caused by Bulk Storage of Granular Materials," involves a study of problems of bulk storage of materials influencing the design of such structures as bins, hoppers, and tanks.

Leo J. Ritter, Jr., has become associate professor of transportation engineering at New York University. Professor Ritter formerly held a similar post at the University of Florida, and last year lectured at the University of the Philippines under a Fulbright Award.

Franklyn C. Rogers has resigned as professor of civil engineering and director of the Joint Highway Research Project at Rutgers University, to return to India as resident engineer for the Harza Engineering Co., of Chicago, consultants to the Damodar Valley Corp., of Calcutta.

Frank T. Sheets, Jr., has been appointed director of engineering and operations of the Southwestern Portland Cement Co., with headquarters in Los Angeles. Mr. Sheets was previously production engineer for the company there.

Roger W. Sheridan announces the formation of Metropolitan Engineers, Inc., with offices in Salt Lake City, Utah. He will serve as president of the new corporation and **David L. Sargent** and **Harold S. Carter** as vice presidents. The corporation will specialize in surveying and engineering services for industrial plants, municipal works, and utilities. Lawrence V. Sheridan & Son, of Indianapolis, Ind., will serve as city planning consultants to the organization.

Frank J. Hanrahan, for the past 16 years chief engineer of the National Lumber Manufacturers' Association, Washington, D.C., has been appointed permanent executive vice president of the American Institute of Timber Construction, with headquarters in the same city. Mr. Hanrahan is a member of the ASCE Structural Division's Committee on Timber Structures and a former president of the Engineers' Club of Washington, the District of Columbia Council of Engineering and Architectural Societies, and the Washington section of the ASME. He arranged the two-day Wood Symposium held during the recent Centennial of Engineering Convocation in Chicago.

F. J. Hanrahan

Morris S. Jones is retiring as chief engineer and general manager of the Pasadena (Calif.) Water Department after 39 years in the department. Mr. Jones was recently appointed a member of the board of directors of the Metropolitan Water District of Southern California to fill the vacancy caused by the death of ASCE Past-President **Franklin Thomas**.

D. C. Hastings is now division engineer for the Richmond, Fredericksburg & Potomac Railroad Co. He was previously supervisor of track for the road at Fredericksburg, Va.

Donald P. Barnes, colonel, Air Force, and until recently director of Ground Defense, headquarters Third Air Force, has accepted employment with the New York firm of Knappen Tippetts Abbett McCarthy, and has gone to Athens, Greece, under a MSA assignment.

Martin King, consulting engineer of Paterson, N.J., has been appointed borough engineer for the Borough of Dumont, N.J. Mr. King was graduated from Massachusetts Institute of Technology in 1947.

Dwight Rutledge, previously chief of the Photogrammetry Section of the U.S. Geological Survey at Sacramento, has been promoted to assistant regional engineer.

Daryl (Jack) Sheridan has been awarded a graduate assistantship at Lehigh University for advance study in engineering. In 1951, Mr. Sheridan received his bachelor of science degree in civil engineering from Bucknell University.

William E. Smith has resigned as civil engineer for the Tennessee Valley Authority at Knoxville, Tenn., to accept employment with the Corps of Engineers at Tullahoma, Tenn.

Edward J. Schaefer, for the past nine years district engineer for the Groundwater Branch of the U.S. Geological Survey at Columbus, Ohio, has established a consulting practice at 607 Glenmont Avenue, Columbus. He will specialize in groundwater supplies, investigations and reports, exploration advice, planning of new developments, induced river infiltration, artificial recharge, well spacing and interference, and well improvement.

Harry E. Squire retired on November 1 after 35 years with the California Board of State Harbor Commissioners. For the past four years he has been chief engineer for the Board at San Francisco.

Donald P. Thayer has entered the employ of the California Division of Water Resources as senior engineer on the design and construction of dams, with headquarters in Sacramento. For the past 14 years Mr. Thayer has been a civil engineer in various offices of the Corps of Engineers, most recently in the New England Division at Boston.

Walter K. Wilson, Jr., district engineer for the Corps of Engineers at Mobile, Ala., has received a new assignment as division engineer for the South Atlantic Division at Atlanta, Ga.

Glenn B. Woodruff announces the removal of his consulting engineering office from 171 Second Street, San Francisco 5, Calif., to 101 California Street, San Francisco 11.

Glenn W. Snow, previously field engineer for the George A. Rutherford Co., Cleveland, Ohio, is now superintendent of the commercial and industrial construction department of Marvin Helf, Inc., builders and brokers of that city.

George O. Zalkind, until recently project manager for Gibbs & Hill, Inc., in New York City, has joined the staff of Knappen Tippetts Abbett McCarthy, New York engineers, for whom he has gone to Rangoon, Burma, on the engineering and economic survey being made for that country.

New Publications

Air Pollution. Chapter 6 of the Air Pollution Abatement Manual, *Sampling Procedures and Measuring Equipment,* has been issued as Manual Sheet P-7 by the Manufacturing Chemists' Association. Prepared by Dr. Paul L. Magill, of the Stanford Research Institute, the chapter sets forth the principles and methods to be followed in the collection of samples used for the study of air-pollution problems, and describes various types of sampling equipment. Orders for Chapter 6 should be sent, with a remittance of 75 cents, to the Manufacturing Chemists' Association, Woodward Building, 15th and H Streets, Washington 5, D.C.

Urban Planning. The relationship between the use of land and the income from that use in the form of property taxes is the subject of a new bulletin by the Urban Land Institute of Washington, D.C. This study, which was developed from analyses of information supplied by cities with a population of 50,000 or more, is entitled *Urban Land Use and Property Taxation* and identified as Bulletin No. 18. Copies may be obtained from the Urban Land Institute, 1737 K Street, N.W., Washington, D.C., at $2.50 apiece.

Design of TVA Projects. Issuance of Volume I of its Technical Report No. 24, *Design of TVA Projects,* is announced by the Tennessee Valley Authority. Entitled *Civil and Structural Design,* the volume is the fourth in a series of special reports prepared to cover important phases of engineering and construction work common to all TVA projects. Subsequent volumes will deal with electrical and mechanical design. The present volume covers project layout, hydraulic design, and design of concrete dams and wall locks, fill dams, powerhouses, and miscellaneous structures. Copies of the 439-page illustrated publication may be purchased from the TVA Treasurer's Office, Knoxville, Tenn., for $2 each.

Pavement Resurfacing. Methods of resurfacing deteriorating pavements with portland-cement concrete and bituminous materials are reported in Bulletin No. 47 of the Highway Research Board. The 39-page illustrated bulletin, a compilation of the Committee on Salvaging Old Pavements by Resurfacing, sells for 60 cents. Inquiries should be addressed to the Highway Research Board, 2101 Constitution Avenue, Washington 25, D.C.

Snow Studies. Cooperative snow investigations made in the Central Sierra Snow Laboratory during the water year, 1948-1949, have been issued by the South Pacific Division of the Corps of Engineers. The U.S. Weather Bureau collaborated with the Corps of Engineers in conducting the studies. Priced at $4.75, the 300-page publication is for sale by the District Engineer, San Francisco District of the Corps of Engineers, San Francisco, Calif.

Earthquake Analysis. A new step-by-step method for the analysis of earthquake stresses in multi-story frame buildings is presented in a reprint made available from the September 1951 issue of the American Concrete Institute. The authors are Charles S. Whitney, M. ASCE, Boyd G. Anderson, and Mario G. Salvadori, A.M. ASCE. The reprint, entitled "Comprehensive Numerical Method for the Analysis of Earthquake Resistant Structures," is available in limited supply from Ammann & Whitney, consulting engineers, 76 Ninth Avenue, New York 11, N.Y.

Timber. To assist engineers and builders in meeting accumulated demands for recreational facilities, the Timber Engineering Co., an affiliate of the National Lumber Manufacturers' Association, is distributing free copies of a new 24-page illustrated booklet entitled *Timber for Recreational Building.* The publication portrays the variety of design obtainable by use of three systems of timber construction: the Teco connector, glued laminated, and Lamella. Requests should be sent to the Timber Engineering Co., 1319 Eighteenth Street, N.W., Washington, D.C.

Aluminum Nomenclature. To promote understanding of aluminum nomenclature, the Sheet and Extruded Products Divisions of the Aluminum Association have issued a glossary of terms for aluminum sheet and plate and aluminum extruded and tubular products. Inquiries should be addressed to the Aluminum Association, 420 Lexington Avenue, New York, N.Y.

Industrial Fastener Standards. Publication of a 256-page revised and enlarged edition of its *Bolt, Nut and Rivet Standards* is announced by the Industrial Fasteners Institute, 3648 Euclid Avenue, Cleveland 15, Ohio. The only publication containing all current standards for commercial fasteners, the volume may be purchased from the Institute at $3 a copy.

Instrument Use. To aid engineers in the field in the use and adjustment of alidades, a 28-page pocket-size service booklet has been published by W. & L. E. Gurley, pioneer manufacturer of engineering instruments. Helpful information for use of the alidade in both exploration and map making, as well as detailed instructions on stadia surveying and the use of the Beaman Stadia Arc are included.

(*Continued on page 88*)

New Publications

Continued from page [illegible]

[illegible] the publication, which is designated as Booklet [illegible]. Free copies are obtainable from W. A. [illegible], Troy, N.Y.

Asbestos-Cement Properties. In its Building Materials and Structures Report 132, the National Bureau of Standards reports physical properties of some samples of asbestos-cement siding. Copies are for sale by the Superintendent of Documents, Government Printing Office, Washington 25, D.C., at [illegible] cents each.

Pressure of Granular Material. A report of experimental and analytical studies conducted by [illegible] and [illegible], Members ASCE, at [illegible] College, [illegible] the lateral and vertical pressures of granular materials [illegible] Bulletin [illegible] of the Iowa Engineering Experiment Station. Copies are available without charge upon application to the Director of the Engineering Experiment Station, Ames, Iowa.

Coast and Geodetic Survey. Additions to the general history of war records being compiled by the Department of Commerce, the Coast and Geodetic Survey has issued a final volume entitled [illegible]. A limited number is available for distribution to libraries and institutions from the U.S. Coast and Geodetic Survey, Washington 25, D.C.

Steel and Iron. A handsome 72-page booklet recording pictorially the contribution of the [illegible] Steel and Iron Company to the growth and progress of the Southeast has been issued by the company to mark a third of a century of service. A limited number of copies is available for free distribution from S. P. [illegible], President, [illegible] Steel and Iron Company, [illegible].

Screw Thread Standards. A 110-page 1950 Supplement to Screw-Thread Standards for Federal Services replaces and supersedes the 1949 Supplement to the National Bureau of Standards Handbook H 28, originally issued in 1944. Prepared under the direction of the Interdepartmental Screw Thread Committee, the supplement indicates a number of changes in American screw thread standards adopted since publication of the 1949 edition. Copies of the revised standard sell for 30 cents upon application to the Government Printing Office, Washington 25, D.C.

Secondary Buckling. The Iowa Engineering Experiment Station presents research findings on the structural behavior of hollow, square and rectangular column sections in a 28-page pamphlet entitled *Buckling in Hollow* [illegible] *Sections*, by Professors Frank Kerekes and W. H. Sunderman. Inquiries should be addressed to the Iowa Engineering Experiment Station, Iowa State College, Ames, Iowa.

Atomic Energy. Major activities in the atomic energy program of the Atomic Energy Commission for the July-December 1951 period have been summarized in the [illegible] Semiannual Report of the AEC. Inquiries concerning purchase of the [illegible] page illustrated report should be addressed to the Government Printing Office, Washington 25, D.C.

Concrete Arches. Availability in reprint form of the Report of Committee 312 of the American Concrete Institute, of which Charles S. Whitney, M. ASCE, is chairman, is announced. Entitled "Plain and Reinforced Concrete Arches," the reprint is available in limited supply from Ammann & Whitney, consulting engineers, 76 Ninth Avenue, New York 11, N.Y.

Hydrodynamic Design. Detailed hydrodynamic design studies for the construction of a [illegible] water tunnel, together with experimental model test data and design analyses of a systematic selection of flow components, comprise Technical Paper No. [illegible], Series B, of the St. Anthony Falls Hydraulic Laboratory. Each flow component [illegible] examined with regard to its influence on test section flow quality, cavitation, separation, and energy head loss. Authors of the [illegible], which is entitled [illegible], are [illegible], associate professor of hydraulics [illegible] of Minnesota [illegible] each from the Laboratory, University of Minnesota, Minneapolis, Minn.

TVA Technical Report. Availability of a 416-page technical report covering surveying, mapping, and related engineering is announced by the Tennessee Valley Authority. Identified as Technical Report No. 23, the publication may be obtained from the TVA Treasurer's Office, Knoxville, Tenn., for $2.25.

Interstate Sanitation. Progress made in pollution abatement during the year under the Tri-State Compact involving projects in New York, New Jersey, and Connecticut is outlined in the 1951 annual report of the Interstate Sanitation Commission. The Commission's program included completion of twelve sewage treatment plants, including the Owls Head Plant in New York and the District No. 2 Plant in Nassau County. Inquiries should be addressed to the Interstate Sanitation Commission, 110 William Street, New York 38, N.Y.

Water Problems. Proceedings of the First Ohio Water Clinic, held at Ohio State University in February 1952, have been issued as Bulletin No. 147 of the Engineering Experiment Station. The program brought together representatives of many different interests in the field of water use including water supply, sewage disposal, industrial waste treatment, conservation, natural resources, litigation, and legislation. Inquiries concerning the publication, which is priced at $1 a copy, should be addressed to the Engineering Experiment Station, Ohio State University, Columbus 10, Ohio.

Bureau of Standards. Scientific and engineering investigations conducted by the National Bureau of Standards in 1951 are summarized in the NBS Annual Report, released as Miscellaneous Publication 204 of the National Bureau of Standards. The text provides a general description of the 15 scientific and technical divisions and gives specific examples of significant projects, many of which were concerned with the defense program. The report may be ordered from the Government Printing Office, Washington, D.C., at 50 cents a copy.

Building Research. Proceedings of the two-day conference on Condensation Control in Buildings, sponsored by the Building Research Advisory Board in February, have been issued as BRAB Conference Report No. 4. The two-day program was primarily concerned with condensation control and its application to paints, papers and insulating materials. Single copies are for sale by the Building Research Advisory Board, 2101 Constitution Avenue, Washington, D.C., at $4.50. Quantity prices will be quoted on request.

Clemens Herschel. The contributions of Clemens Herschel, Past President and Hon. M. ASCE, to the science of hydraulics are commemorated in an interesting illustrated brochure issued by Builders-Providence, Inc., makers of recording and controlling instruments. Identified as Bulletin 100-117, the publication consists of articles about Mr. Herschel by his contemporaries, especially in relation to his development of the Venturi Meter. Inquiries should be addressed to Builders-Providence, Inc., 345 Harris Avenue, Providence, R.I.

Highways. Five bulletins treating various phases of highway work have been released by the American Road Builders' Association. They are No. 181, "Experimental Use of Lime for Treatment of Highway Base Courses," 30 cents; No. 182, "The Value of Welded Wire Fabric in Concrete Slabs," 25 cents; No. 183, "Looking Ahead with Soil-Cement in Louisiana, and Reconstruction of Lubbock, Tex., Airport with Soil-Cement," 30 cents; No. 184, "Developments in Iowa's Secondary Road Soil Stabilization," 25 cents; and No. 185, "Lime Stabilization in District 14, Texas Highway Department," 25 cents. Orders will be filled by the ARBA, International Building, Washington 4, D.C.

Earthquakes, San Francisco. To familiarize persons interested in earthquake insurance with the seismic history of the San Francisco Bay area, the Pacific Fire Rating Bureau has published a pertinent extract from *The Geologic Guidebook of the San Francisco Bay Counties*, by Prof. Perry Byerly, director of the Seismological Station at the University of California. Single copies of the published extract are available from the Pacific Fire Rating Bureau, 465 California Street, San Francisco [illegible].

Reinforced Concrete. A recent revision of the *Manual of Standard Practice for Detailing Reinforced Concrete Structures*, adopted as a standard of the American Concrete Institute in 1948, has been made available by the ACI. The purpose of the manual, which was prepared in cooperation with the Concrete Reinforcing Steel Institute, is to present improved methods and standards for preparing drawings for the fabrication and placing of reinforcing steel. Typical engineering and placing drawings are shown to illustrate the use of the standards. The publication (identified as ACI 315-51) may be ordered from the ACI, 18263 West McNichols Road, Detroit 19, Mich. The price is $3 a copy.

Structural Design. For the convenience of engineers preparing for the professional engineer examination, David Singer, design engineer with Corbett Tinghir and Co., Inc., of New York, has prepared a text based on his review course for the Professional Engineer license examination first given under the auspices of the Kings County Chapter of the New York State Society of Professional Engineers. Entitled *Basic Structural Design*, the loose-leaf mimeographed text may be purchased from Peles Publishers, 50 Liberty Street, New York 6, N.Y. The price is $4.50.

New York State Building Code. As a guide to the interpretation, application and enforcement of the New York State Building Code, the State Building Code Commission has issued a *Code Manual*. The 300-page loose-leaf publication is divided into five parts corresponding to the five major subdivisions of the one- and two-family dwelling code. These are general provisions, space standards, structural standards, fire-fighting standards, and equipment standards. For the convenience of users, the text of the one- and two-family dwelling code is included in the Manual. Sections of the code are correlated with sections of the manual by a numbering system that expedites finding standards of materials and methods applicable to the code requirements. The price has been fixed at $2 a copy to cover printing and mailing costs. Checks should be made payable to the order of the State Building Code Commission and mailed to 1740 Broadway, New York 19, N.Y.

Parking. The problem of financing parking is discussed in an illustrated report prepared by the Automotive Safety Foundation for the National Retail Dry Goods Association. Prepared with the aim of providing basic information on each method of financing and important variations of methods that have been used, the publication is an objective reporting of local beliefs and of measures taken by both private enterprise and cities. Research and writing were done by E. Earle Duffy, public relations, and the technical consultant was D. Grant Mickle, M. ASCE, director of the Traffic Engineering Division of the ASF. A price of 75 cents has been placed on the book, but for quantities of 100 or more sent to one address, the price is reduced to 60 cents. Distribution is being handled by the Automotive Safety Foundation, 700 Hill Building, Washington 6, D.C.

Materials Testing. Issuance of a detailed author and subject index to all the ASTM technical papers and reports dealing with materials (particularly their properties and testing) appearing in ASTM publications during the period from 1898 through 1950 is announced by the American Society for Testing Materials. The index features certain innovations; for instance, the author index, which precedes the subject listings, gives the complete titles of papers and items covered, making it possible to present the subject index in a condensed and more easily usable form. The 216-page publication (red cloth, 6 by 9 in. format) can be obtained from the ASTM Headquarters, 1916 Race Street, Philadelphia 3, Pa. The cost is $6 a copy.

Vector Analysis. In an effort to make vector analysis understandable to students, Earl C. Rex, assistant professor of physics at George Pepperdine College, has prepared an 88-page text on the subject. Engineering applications include sections on forces on struts on planes and in space; shafts connecting two points or two tunnels along the shortest line; transition surfaces; lever problems; highway analyses by curvature and tortuosity; auto ramps and circular staircases; deformation due to torques on drive shafts and tensions on helical springs; and gyroscopic motion. Copies may be purchased from the Educational Book Division of the Wm. C. Brown Company, 915 Main Street, Dubuque, Iowa, at $3.25 each.

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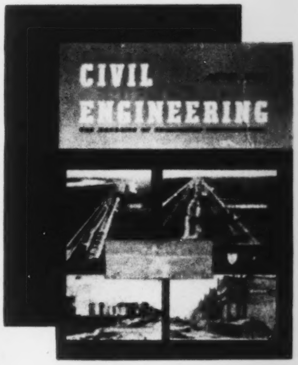

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RECENT BOOKS

Highway Curves

A presentation of the theory and practice of highway curves as practiced in this country, together with the mathematical tables required in road building. Principles of highway economics and the use of aerial mapping and state coordinates are outlined in the early sections on location procedure and the preliminary survey. The considerable revision in this edition includes the treatment of compound and reversed curves, vertical curves, spirals, and sight distances on sags and summits, and a general increase in precision and simplicity. The authors are Howard S. Ives and Philip Kissam. (John Wiley & Sons, Inc., New York, N.Y., fourth edition, 1952. 389 pp., $7.)

Instrument Engineering—Volume I, Methods for Describing the Situations of Instrument Engineering

The complete three-volume set will present a generalized method of attack on the problems of measurement and control as a comprehensive reference for the practicing engineer or an extensive textbook. Volume I develops a system of concepts, notations, diagrams, and mathematical forms for describing the performance of physical devices and variations in physical quantities. It also provides a description of the physical circumstances under consideration by means of diagrams, mathematical forms, curves, and numerical data. The authors are Charles Stark Draper, Walter McKay, and Sidney Lees. (McGraw-Hill Book Co., 330 West 42nd St., New York 36, N.Y., 1952. 290 pp., $6.)

Examples of the Design of Reinforced Concrete Buildings

Part II of this volume contains detail drawings and calculations for the design, in accordance with the British standard codes, of the principal parts of a five-story reinforced-concrete building. Comments on the calculations and drawings are given in Part I, together with tables and graphs summarizing the requirements of the codes and for the rapid assessment of bending moments in continuous beams, shearing resistance of groups of bars, allowable loads on columns, etc. Although the building considered has floors of ordinary beam and slab construction, designs for slabs spanning in two directions and flat slabs are also given. The author is Charles E. Reynolds. (Concrete Publications Limited, London, 1952. 214 pp., $2.40.)

Handbook of Applied Hydraulics

A general reference work on hydraulics composed of brief, yet complete texts on its various branches with practical information on the planning and design of hydraulic works. Hydrology, river regulation, dams, spillways, canals, hydroelectric plants, hydraulic machinery, water supply, sewerage, irrigation, etc., are discussed by twenty-two prominent engineers dealing with their specialized fields. New sections have been added on water hammer, surge tanks, speed regulation, and navigation locks. Hundreds of graphs, diagrams, photographs, and detailed sketches supplement and illustrate the text. Edited by Calvin Victor Davis. (McGraw-Hill Book Company, Inc., 330 West 42nd Street, New York 36, N.Y., second edition, 1952. 1,272 pp., $15.)

International Association for Bridge and Structural Engineering

The sixteen papers presented in this publication, the Association's eleventh volume, deal with a variety of subjects within the field of interest. Analysis of space frames, Vierendeel trusses, corrugated concrete shell structures, suspension bridge calculations, membrane theory of thin plate structures, buckling of circular rings, stresses in ceilings with panel heating, and several stress, load, and deformation experiments or analyses of various structural elements. Articles are in English, French, or German with summaries in the other two languages. (Verlag Leemann, Zurich, Switzerland, 1951. 388 pp., Sw. Fr. 18 for members.)

Numerical Methods in Engineering

Numerical methods using series expansions, successive approximations, and other non-analytical solution methods are described with illustrative problems from the fields of mechanics, strength of materials, electricity, elasticity, plasticity, heat flow, vibrations, etc. Finite difference theory is the unifying basis of the techniques which cover algebraic and transcendental equations, initial value and ordinary boundary value problems, and partial differential equations. The numerical tools to which these techniques can be applied are the electric desk calculator and, in many cases, the slide rule. The authors are Mario G. Salvadori and Melvin L. Baron. (Prentice-Hall, Inc., 70 Fifth Avenue, New York, N.Y., 1952. 258 pp., $6.65.)

Public Roads of the Past 3500 B.C. to 1800 A.D.

A series of 21 articles, reprinted from *American Highways*, 1944-1949, and relating mainly to the roads and highways of the old world, constitute this volume. They include general historical and technical information, biographical details of important personages, and special topics such as the reasons behind the wheel gage, the origin of engineering measures, the background of grade restrictions, the right hand rule of the road, etc. A second volume will include the chapters, beginning with January 1950, which deal with American road development. (Published by the American Association of State Highway Officials, 917 National Press Building, Washington 4, D.C., 1952. 101 pp., $3.)

Quarrying Stone for Construction Projects

Current practice in commercial quarries in the United States is described in this volume by H. Streefkerk. The book begins with general information on rock types and a discussion of exploratory work and development plans. Types of equipment and methods of operation are covered in detail but specialized blasting information is omitted. Major topics are the production of concrete aggregate and stone for breakwaters, covering methods and selection of proper equipment in each case. (Van Riemsdyck Book Service, Inc., 207-211 East 37th Street, New York 16, N.Y., 1952. 159 pp., $5.)

Steelwork in Building

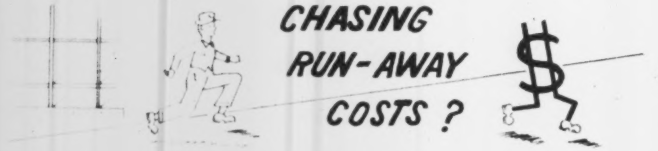
This volume by William Basil Scott contains the text of British Standard 449, "The Use of Structural Steel in Building," with interspersed commentary by a member of the committee that drafted the standard. Item by item, the specifications are explained or interpreted for the practical use of civil, mechanical and structural engineers, building contractors, etc. Fundamental technical data and approved practice recommendations are presented in detail. (E. & F. Spon, Ltd., 22 Henrietta Street, London, W.C. 2, England, 1952. 203 pp., 25s.)

Symposium on Consolidation Testing of Soils

Testing techniques, the effect of certain variables on soil characteristics, reports on actual consolidation tests, and discussions of observed settlements of railway and highway structures are included in the eight papers presented. A general discussion section follows the whole group of papers. (American Society for Testing Materials, 1916 Race Street, Philadelphia 3, Pa. Special Technical Publication No. 126, 1952. 109 pp., $1.75.)

Writing the Technical Report

The first part of the book—by J. Raleigh Nelson—presents a review of the fundamental considerations bearing on the design and composition of the report. The second gives specific directions for the form and style of the report, with several examples. The third outlines a systematic procedure



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for the critical examination of a report. The last two parts provide a summary of basic principles and a suggested series of assignments for classroom use. The whole is designed to supply a basic approach and pattern as well as the incidentals of form and convention. (McGraw-Hill Book Co., 330 West 42nd Street, New York 36, N.Y., third edition, 1952. 156 pp., $4.50.)

Engineering in Public Health

Although this volume is written primarily for civil engineers, its thorough coverage of preventive and corrective measures in sanitary engineering will be useful to others in the field of public health. Among the subjects discussed by the author, Harold E. Babbitt, are administration, control of environment for comfort and protection of health, communicable diseases with their causes and control, new germicides, and modern disinfecting methods. (McGraw-Hill Book Company, Inc., 330 West 42nd St., New York 36, N.Y., 1952. 582 pp., $8.)

Handbook of Engineering Fundamentals

This companion volume (edited by Ovid W. Eschbach) to the specialized handbooks of the "Wiley Engineering Handbook Series" contains the fundamental laws, theories, and data that are basic to engineering practice. Revisions consist of deletions, additions, and changes indicated by 16 years' experience with the first edition, one significant aspect being the much greater emphasis on the use of the MKS system of units. The subject matter is essentially an extended summary of the principles of mathematics, physics and chemistry, the commonly used mathematical tables, the properties and uses of materials, and the mechanics of solids and fluids. A discussion of engineering law is included. (John Wiley & Sons, Inc., 440 Fourth Ave., New York 16, N.Y., second edition, 1952. $10.)

Hydraulik und Wasserbau auf Neuen Grundlagen

Intended for all engineers active in the hydraulic engineering field, this book by A. Schafer presents a comprehensive treatment of modern hydraulic theory. The approach is basically mathematical but abstract concepts are kept to a minimum to retain a close alliance with practice. In many instances new methods are described. The book is meant to be not only a systematic textbook but also an inspiration and guide to progressive and economic construction. (Franckh'sche Verlagshandlung, Stuttgart, Germany, 1950. 187 pp., DM 35.)

Die Kugelschlagprufung von Beton

The author, Kurt Gaede, describes and evaluates tests on compressive strength of concrete made by a dynamic ball-impact test method using special spring and pendulum hammers. Practical applications of this method are discussed. (Wilhelm Ernst & Sohn, Berlin, 1952. 73 pp., DM 7.50.)

Anschauliche Verfahren zur Berechnung von Durchlaufbalken und Rahmen

This text by Robert V. Halasz provides a simple method for a detailed analysis of continuous frames by moment and shear distribution. It also discusses balancing angle changes and presents a simple iteration method of solving elasticity equations. (Wilhelm Ernst & Sohn, Berlin, 1951. 158 pp., DM 31.50.)

(*Continued on page 92*)

Library Services

Engineering Societies Library books may be borrowed by mail by ASCE members for a small handling charge. The Library also prepares bibliographies, maintains search and photostat services, and can provide microfilm copies of any items in its collection. Address inquiries to Ralph H. Phelps, Director, Engineering Societies Library, 33 West 39th Street, New York 18, N.Y.

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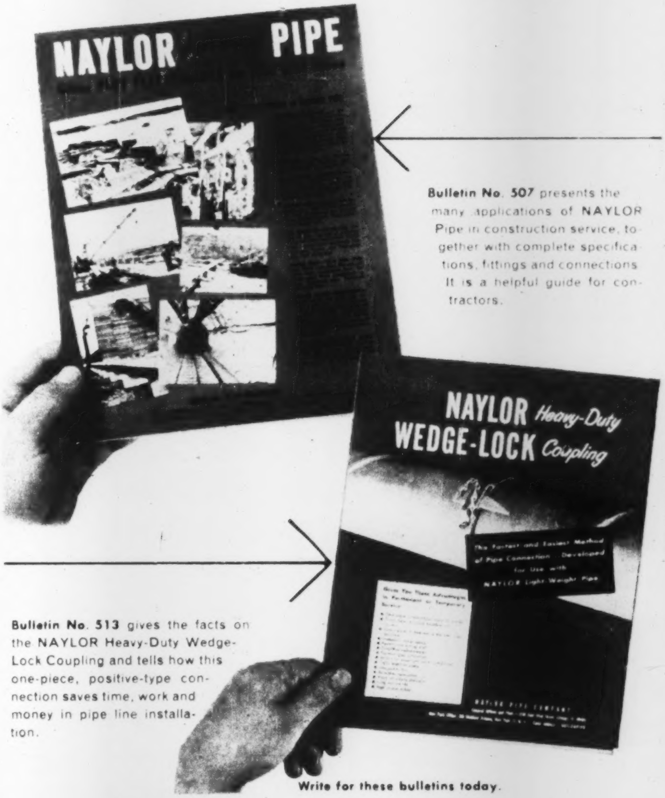
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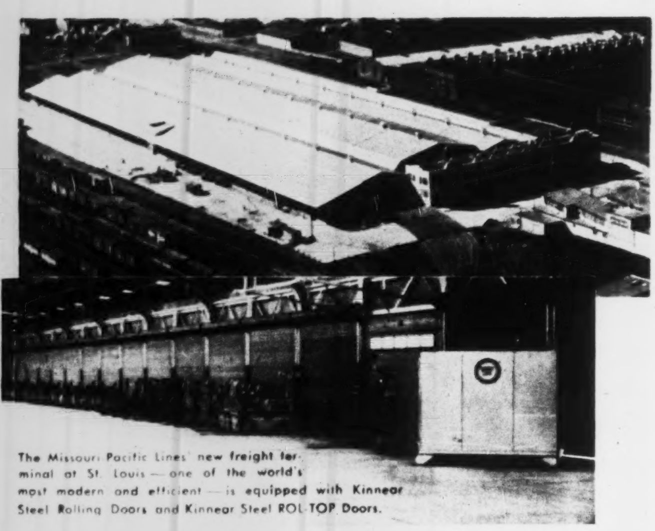

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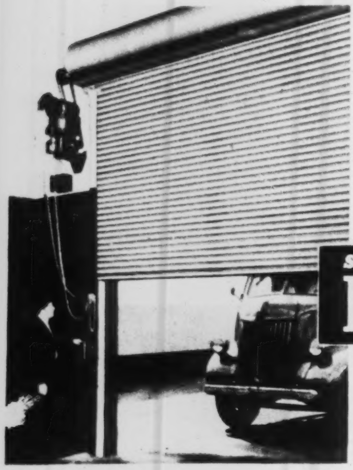

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Recent Books

(Continued from page 91)

Compressed Air in Mining and Industry

The important applications of compressed air are described by Sydney H. North, compiler and editor, with comments on its advantages and limitations. The following topics are representative: Pneumatic tools of all kinds; operation of remote mechanisms; conveying and air lift pumping; tunnel work and ship salvage; and air blast devices. There is also a concise presentation of compressor operation and maintenance. (Pitman Publishing Corp., 2 West 45 St., New York 19, N.Y., 1951. 170 pp., $4.)

Advanced Strength of Materials

Starting from the level attained by the first one-term course in engineering colleges, this volume covers the following major subject headings: Torsion; rotating disks; membrane stresses in shells; bending of flat plates; beams on elastic foundation; two-dimensional theory of elasticity; the energy method; buckling; miscellaneous topics such as Mohr's circle and certain specialized theorems. The author is J. P. Den Hartog. (McGraw-Hill Book Co., 330 West 42nd Street, New York 36, N.Y., 1952. 379 pp., $8.50.)

Applied Structural Design

The general arrangement of this manual, by Thomas H. McKaig, carries the subject from the mathematics and mechanics of structural engineering through the theory of bending into the practical application to building problems. Expanded from a series of preparatory notes for state license examinations, the book contains the tabular and graphical information the author has had most occasion to use in actual practice. The methods and basic data used are in accordance with prevailing standard building codes. The book is intended as a practical handbook for the structural designer rather than as a textbook. (Published by the author, 881 Main St., Buffalo 3, N.Y., 1949. 505 pp., $10.)

Ausfuhrung von Stollenbauten in Neuzeitlicher Technik

In this condensed treatment of modern methods of tunnel construction, Karl Wiedemann presents practical suggestions for the experienced engineer who is already familiar with the fundamentals of underground construction work, explosives, statics, surveying, construction machinery, etc. Major sections are on tunneling practice, special machinery and equipment, and operating procedures. There is a bibliography. (Wilhelm Ernst & Sohn, Berlin, 1952. 136 pp., DM 18.50.)

Beton-Kalender 1952

A pocket-sized handbook in two volumes dealing with concrete, reinforced concrete, and related fields. Part I contains mathematical tables, properties of materials, statics, dimensioning of members, and pertinent German specifications. Part II covers estimating of reinforced-concrete structures, foundation practice, retaining walls, building walls and floors, prefabricated members, bridges, elastic slabs, road construction, silos, and concrete pipe. (Wilhelm Ernest und Sohn, Berlin-Wilmersdorf, Vol. 41, two parts, 1952. 736 pp., 412 pp., DM 16.)

Calculus of Variations, With Applications to Physics and Engineering

Following a brief treatment of the classical elementary problems, the author, Robert Weinstock, provides sections involving the role of the calculus of variations in particle dynamics, geometrical optics, quantum mechanics, elasticity, electrostatics, and in the eigenvalue problems associated with the vibrating string and vibrating membrane. Techniques and underlying ideas are emphasized. (McGraw-Hill Book Co., 330 W. 42nd St., New York 36, N.Y., 1952. 326 pp., $6.50.)

Charting Statistics

This liberally illustrated textbook, by Mary Eleanor Spear, employs drafting-room methods of charting for practical graphic presentation of statistical data. Various interpretations of the same tables are used to illustrate the types of charts applicable to the given tables of facts. Among the varieties discussed are line, surface, column, bar, map and flow charts. (McGraw-Hill Book Co., 330 W. 42nd Street, New York 36, N.Y., 1952. 253 pp., $4.50.)

Corrosion Testing Procedures

Intended mainly for the investigator concerned with practical problems in the corrosion of metals in service and the production of corrosion-resistant metal, this manual by F. A. Champion covers in detail the alternative procedures for all stages of corrosion tests: choice and preparation of metal and corrosive agent; exposure conditions for both laboratory or field tests; examination of specimens or corrosive agent for effects of corrosion; expression and interpretation of results with particular reference to the corrosion-time curve. Various special tests are considered separately. (John Wiley & Sons, Inc., 440 Fourth Ave., New York, N.Y., 1952. 369 pp., $6.25.)

Textbook of Wood Technology, Volume II: The Physical, Mechanical, and Chemical Properties of the Commercial Woods of the United States

Completing a comprehensive two-volume treatment of all phases of wood technology, this second volume covers three major aspects as follows: The physical properties of wood, including bonding and finishing; mechanical properties of wood, including testing procedures, design of typical timber structures, determination of stresses in framed structures, and the holding power of timber connectors; chemical properties of wood. The authors are H. P. Brown, A. J. Panshin and C. C. Forsaith. The forestry and commercial timber aspects were covered in volume I. (McGraw-Hill Book Co., Inc., 330 West 42nd St., New York 36, N.Y., 1952. 783 pp., $10.)

Industrial Waste Treatment

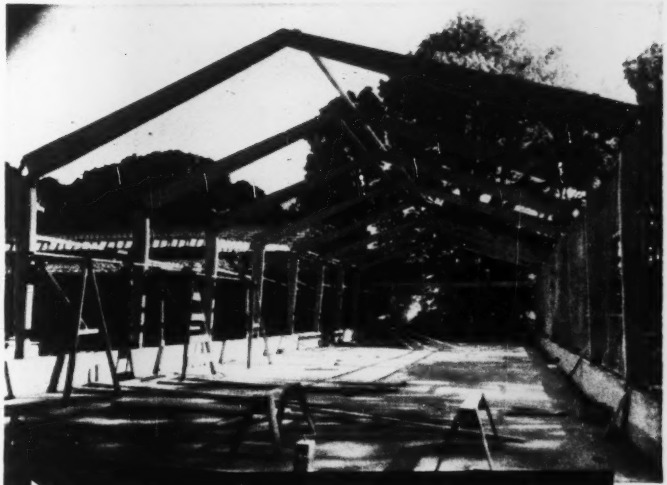
Beginning with discussion of the nature, cause, and general aspects of an industrial waste problem, the author, Edmund B. Besselievre, first establishes basic methods of approach to a solution. Technical subjects covered include sampling and analysis of wastes, pollutional effects, methods of waste treatment, handling methods, and the recovery of usable materials. Legal factors and economic aspects are thoroughly covered. (McGraw-Hill Book Co., Inc., 330 W. 42nd St., New York 36, N.Y., 1952. 391 pp., $7.)

Hydraulics and Its Applications

The new edition of this well-known textbook, by A. H. Gibson, has been revised to eliminate obsolete matter and by the addition of new material provide an up-to-date coverage of the subject. A new chapter dealing with the basic principles of the construction and operation of scale models has been included. The introductory Section I covers hydrostatics and the physical properties of water, Section II hydraulic theory for a variety of conditions, and Section III the design of hydraulic machinery. (Constable & Co., Ltd., London, 1952. 813 pp., 35s.)

Solution to problem on page 33

Confined sand and stone is an excellent bearing medium. However, the procedure was criminally unsafe because the metal shell would eventually rust through. The aggregate, no longer confined, would be unable to resist load effectively. After a concrete pier is cast, the shell is not an essential item.



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Sales Engineer or Manufacturers' Representative, A.M. ASCE, 47, married, graduate civil engineer; would like to handle building products or machinery; 8 years experience as sales engineer, promotional sales, missionary work in building materials; 20 years as engineering college professor. C-793-522-A-12-San Francisco.

Civil Engineer, M. ASCE, 45, married; B.S. in C.E.; registered; World War II service U.S. Corps of Engineers project engineer; superintendent of construction and university teaching of design. With present employer past 6 years. At present on railroad terminal project but desires position with some major firm, such as a consulting firm, in a supervisory or executive capacity. Will travel. C-794.

Civil Engineer, J.M. ASCE, 30, married; 7 years varied industrial building construction experience including field work, cost analysis, expediting, estimating; at present resident engineer in charge of contract letting and administration. Desires responsible position with expanding company with opportunity of profit sharing. Prefers upstate New York. C-795.

Civil Engineer, J.M. ASCE, 30, married; B.S. in C.E.; 7 years experience in hydraulic design, flood control work and construction. Desires position in hydraulic or related field as design or construction engineer. Will relocate; will also consider foreign employment. C-796.

Civil Engineer, J.M. ASCE, 26, married; B.S. in C.E.; registered professional engineer; over 5 years wide and varied engineering experience; railroad field and office, construction supervision, inspection and management; experienced structural designer; chemical plant engineering experience. Recalled Naval C.E.C. Officer, currently overseas. Desires position with challenge and opportunity; any location. Will be available February 1. C-797-529-A-3-San Francisco.

Civil Engineering, J.M. ASCE, 29, registered land surveyor; B.S. in C.E.; 2½ years experience surveying, geodetic, topographic and pipe line layout; 1½ years as geodetic field engineer in South America; 1 year layout and design in light construction; desires foreign employment, especially Latin America. C-798-Detroit.

Positions Available

Engineer, B.S. in civil engineering or equivalent to include most of the following courses: Dynamics, aerodynamics, differential equations, statistics, stress analysis, structural design; to plan, conduct and evaluate field tests of operational engineering techniques as applied to certain phases of atomic energy program. Will consider a recent graduate. Salary, $5,410-$7,040 a year. Location, Virginia. Y-7292.

Engineers. (a) Construction Superintendents, three for overseas duty and one for domestic. Must have minimum of 8 to 10 years' experience in the construction of hydroelectric power stations. Salary, $15,000 a year plus 20 percent for overseas service. (b) Resident Engineers for similar work as above. Salary, $9,000 a year. Headquarters, New York, N.Y. Y-7350.

Manager of Building Products Sales, 35-40, with sales background and engineering experience, for work involving the development of new building products. Must be able to handle normal sales management and advertising duties and have imagination and the ability to produce new products. Salary, $7,500 a year to start. Location, Ohio. Y-7353.

Research Assistant, recent civil engineering graduate, for work on research project involving the investigation of structural members for use in supporting structures for ground electronic operations. Duties include preparation of engineering drawings, engineering computations, conducting lab tests and assembling resulting data. Opportunity to pursue graduate work toward master's degree in civil engineering, and also instructing in laboratory work during

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Recent Civil Engineering Graduate for engineering field service on low-cost road construction. Highway experience desirable. Good opportunity with national organization. Location, Southeast. V-7387.

Professor in Civil Engineering, 35-40, for the school year 1953-1954 to act as department head. Should have engineering and teaching experience. Salary, $4,500-$5,000 for 8½ months. Location, Pennsylvania. V-7446.

Engineers. (a) Resident Engineer with at least 5 years' experience covering railroad or highway engineering, aerial surveys, layout curves, solar observations. Salary, $9,600 a year. (b) Instrumentman with railroad or highway field experience to run level and transit covering locations and construction. Salary, $7,200-$8,400 a year. (c) Office Engineer with at least 5 years' railroad and highway experience including design and computation work. Salary, $10,000 a year. (d) Draftsman-Computer to compute field notes, lay out right of way, do topographical work, etc., on railroad project. Salary, $7,200 a year. Knowledge of Spanish and Portuguese desirable. Bonus of 15 percent on all jobs at completion of contract. 2-3 years' work. Location, Brazil, S.A. V-7452.

Editorial Assistant, young, to write up new products for civil engineering construction magazine. Also prepare market research reports. Residents of New York Metropolitan Area only. Salary, $3,600-$4,200 a year. Location, New York, N.Y. V-7481.

Civil Engineer with B.S. degree and 4 years' experience in technical engineering and 1½ years' professional experience in engineering. Must have demonstrated ability to perform difficult engineering work under only general supervision. Salary, $5,060 a year plus 25 percent cost-of-living allowance, making total of $6,325 a year. Must be a citizen. Location, Alaska. V-7504.

Resident Engineer with at least 10 years' design and field experience on industrial buildings and process equipment installation. Salary, $8,000 a year. Location, Brooklyn, N.Y. V-7517.

Sales Engineers to call on engineers, architects and contractors. Must have had construction and preferably sales experience. Prefer someone who has worked with a cement company or a concrete testing laboratory. Salary, $4,200-$5,400 a year plus commission and expenses. Locations, New York Metropolitan Area, Chicago and Canada. Good opportunity as applicants will have the advantage of eventually heading up branch offices. V-7536.

Sales Engineer, young, mechanical or civil, not necessarily a graduate but with two to three years' college, for inside sales work such as estimating, sales correspondence, promotional work with design engineers and architects; also some outside contact with customers. Should have a car. Salary open. Location, Newark, N.J. V-7560.

Construction Engineer with pipeline, marine terminal, tank car and truck station experience to supervise design changes, field engineering and equipment installation. One-year contract. Salary, $9,600-$10,200 a year. Location, North Africa. V-7595.

Construction Superintendent, not over 47, M.E. or C.E. degree, with at least 10 years' experience in heavy construction involving a considerable length of time in full charge of projects. Must have had petroleum refinery or heavy industrial chemical plant experience. Will be 100 percent field work at the actual construction site. Salary, $7,200-$7,500 a year plus expenses. Locations, throughout the United States. V-7626.

Sanitary Engineer, 30-45, graduate with degree in sanitary engineering or civil engineering with minor in sanitary engineering or chemistry, and at least 5 years' experience in a waterworks system, public health activities in sanitary engineering sales. Will act as assistant to the water supply superintendent to supervise the water purification and sanitary engineering sales. Must be U.S. citizen. Salary, $5,588-$6,644 a year to start. Location, Florida. V-7664.

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Continued on page 98

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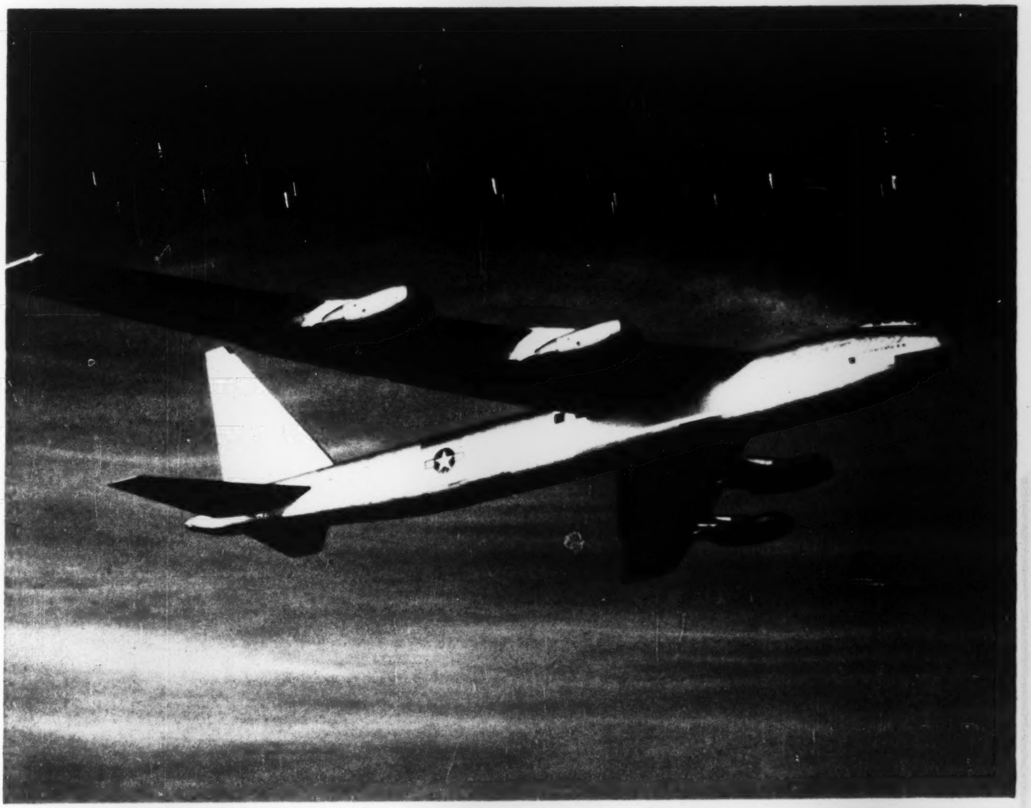

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(*Continued from page 96*)

Hydraulics Engineer, under 35, B.S., M.S. or Ph.D. degree in civil or mechanical engineering, with major in fluid mechanics. Will consider men with or without actual work experience, but should have some knowledge of research techniques gained through independent investigation such as thesis work for university degree. Knowledge of construction of experimental apparatus, operation of pilot plant equipment and an understanding of mechanical principles is desirable. Work involves translation of research results into pilot plant and production installations. Salary, $3,600-$6,000 a year. Location, Midwest. Y-7763.

Executive Engineer, 40-50, civil graduate with structural design, including moment distribution estimating and sales experience covering bridges, railroads, and industrial buildings construction for engineering and construction firm. Professional license desirable. Salary, $10,000-$12,000 a year. Location, Maryland. Y-7781.

Office Engineer capable of managing an office in New York for a multi-million dollar construction job. Will handle all phases of office details, set up and organize prior to the starting of field construction. Duration, 4 or 5 years. Salary open. Location, New York, N.Y. Y-7788.

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Project Engineer to take charge of several projects in so far as checking job and materials is concerned for large construction company engaged in industrial and commercial building in Eastern area. Some traveling. Salary, to $7,500 a year. Location, New York, N.Y. Y-7807.

Staff Engineer, construction, 30-45, with civil engineering degree preferred and up to 10 years' experience in similar work described below. Will act as office engineer and resident engineer on industrial plant changes and expansion, large and small projects. Broad experience required on building construction. Knowledge of equipment erection desirable. Able to review structural designs and suggest improvements, make cost estimates, review proposals and advise on letting contracts. Act as company representative on projects away from home office. Travel required. Salary, $5,400-$6,800 a year. Location, New Jersey. Y-7820 (a).

Instructor, young, preferably with a master of science degree, who is interested in teaching engineering graphics and descriptive geometry. Will consider industrial, mechanical or civil engineer. Salary open, sick leave and retirement benefits. Location, Midwest. Y-7830.

Sanitary Engineer with experience in design and layout of sewage disposal plants and systems. Salary, $5,000-$6,000 a year. Location, New York, N.Y. Y-7839.

Designer, with at least 5 years' experience in designing structural steel and reinforced concrete, 70 percent on structural steel and concrete design and 30 percent on architectural design of industrial buildings. Permanent, not defense. Salary, $10,000 a year. Employer will pay fee. Location, Indiana. R-9285.

Positions Announced

Engineer Center, Fort Belvoir. Openings available at the Engineer Center, Fort Belvoir, Va., include the following: Bridge engineer at a yearly salary of $3,410; civil engineer at salaries ranging from $3,410 to $5,940; structural engineer at salaries from $4,205 to $5,060; and training instructor in civil engineering at $5,060. The applications for federal employment, standard form 57, may be obtained from a Civil Service Office or Department of the Army Civilian Personnel Office, and should be mailed or presented in person to the Civilian Personnel Branch, Building 211, Room 200A, the Engineer Center, Fort Belvoir, Va.

(*Continued on page 100*)

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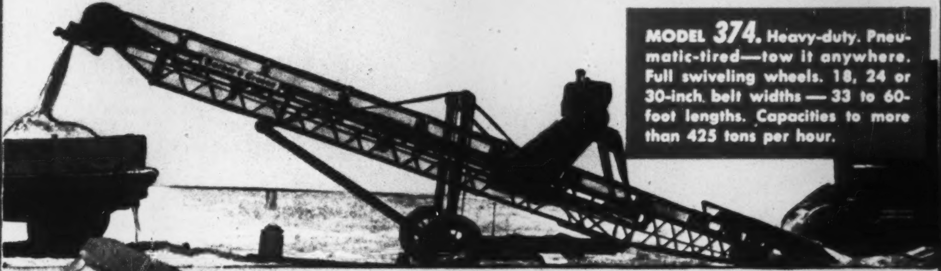

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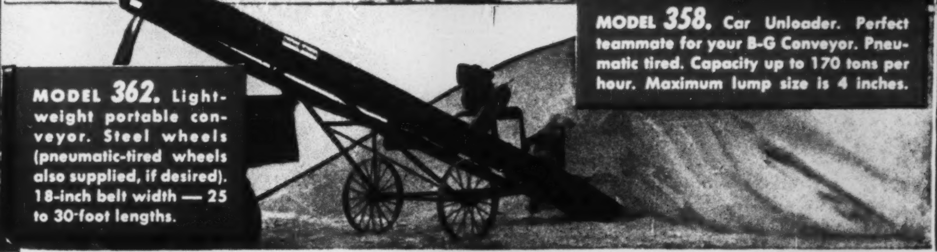

MODEL 362. Lightweight portable conveyor. Steel wheels (pneumatic-tired wheels also supplied, if desired). 18-inch belt width — 25 to 30-foot lengths.

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Positions Announced

(Continued from page 98)

Corps of Engineers, Philadelphia District. Civilian construction inspectors and civil, electrical, and mechanical engineers are urgently needed for vital military construction projects in New Jersey, Delaware and Pennsylvania. For more detailed information write to the Personnel Branch, Army Engineers, 121 North Broad Street, Philadelphia, Pa.

Corps of Engineers, Portland District. The Personnel Branch of the Portland District currently lists 92 different types of civilian engineering vacancies at 15 foreign stations with salaries ranging from $3,175 to $10,800. Qualified personnel should contact Roy H. Lusch, 627 Pittock Block, Portland 5, Ore., for further information.

Corps of Engineers, New York District. An urgent need for experienced safety engineers (GS-9) at an annual salary of $5,060, to check and recommend safety measures and hold conferences with construction engineers, is announced by the New York District of the Corps of Engineers. Interested applicants should communicate with the Personnel Branch, Corps of Engineers, U. S. Army, Office of the District Engineer, New York District, 80 Lafayette St., New York 13, N.Y.

U. S. Civil Service Commission. Announcement is made by the U. S. Civil Service Commission of an examination for highway engineer trainee jobs in the Bureau of Public Roads, paying $3,410 a year. All applicants must pass a written test, have had appropriate education or experience and must be between 18 and 35. Further information and application forms may be obtained from the Post Office or the U. S. Civil Service Commission, Washington 25, D. C. Applications will be accepted until February 10, 1953.

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Atomic Power . . .

This article begins on page 41

(Continued from page 45)

for weapons material and mobile military atomic power plants, are furnishing an advancing technology which is very beneficial to commercial atomic power.

It is conceivable that within the next few years, it will be desirable to carry out the development, construction, and operation of dual-purpose atomic power plants, but for the reasons given, I doubt if such plants will be either privately financed or numerous. It is at this time very difficult to predict just when single-purpose atomic power plants will be built. But there is a great deal of optimism and confidence among informed people about the eventual future of atomic power.

The General Electric Co. is a potential manufacturer of equipment for atomic power plants. The company is also interested in the future of any source of energy which holds promise of making more electricity available to the public at lower cost. The company has undertaken three major commitments in this field: the production of plutonium at Hanford, development of naval reactors at Knolls Atomic Power Laboratory, and the development of an atomic propulsion system for aircraft at Lockland, Ohio. The commitment of technical manpower to atomic energy projects is between 10 percent and 15 percent of the company's total technical employees. Obviously, while each project has its own motivating reasons, such a large-scale commitment to special projects would not be made or continued if responsible people did not believe that future benefits of commercial atomic power would eventually result.

Non-ASCE Meetings

American Society of Photogrammetry. The 19th annual meeting of the American Society of Photogrammetry will be held at the Shoreham Hotel, Washington, D.C., on January 14, 15, and 16. A pre-program tour of the Engineer Research and Development Laboratories, Fort Belvoir, Va., will be conducted on Tuesday afternoon, January 13.

Chi Epsilon. A meeting of the New York Alumni Chapter will be held in the Engineering Societies Building, Room 1401, 33 West 39th St., New York, N.Y., on January 7, at 7:30 p.m. It will be preceded by an informal dinner in the New York Times Dining Room, 11th floor, 229 West 43rd St., at 6 p.m.

Highway Research Board. Headquarters for the 32nd annual meeting of the Highway Research Board, scheduled for January 13-16, will be the building of the National Academy of Sciences at 2101 Constitution Ave., Washington, D.C.

American Society of Agricultural Engineers. The winter meeting of the society will take place at the Stevens Hotel in Chicago, Ill., from December 15 to 17.

Society of Automotive Engineers. The Sheraton Cadillac in Detroit, Mich., will be the scene of the annual meeting and engineering display of the Society of Automotive Engineers, from January 12-16.

Applications for Admission to ASCE, October 18–November 15

Applying for Member

Michel Bakhoum, Giza, Egypt
Caesar Rodney Baxter, Chatham, Ill.
Edwin Forrest Biggs, Charlotte, N.C.
John Parke Boyer, Decatur, Ill.
Jesse Boyer Budd, Jr., McCook, Nebr.
Victor Renville Coolidge, Berkeley, Calif.
Theophilo Garcez Duarte, Jr., Parana, Brazil
Charles Philip de Biasi, New London, Conn.
Paolo de Martino, New York, N.Y.
Howard Gist Dixon, New York, N.Y.
Raymond Craig Frith, Darwin, N.T., Australia
Frank Edward Gerlitz, Jr., Philadelphia, Pa.
Albert William Grohne, Kansas City, Mo.
Lewis Sharswood Harvey, Charleston, W. Va.
Curtis James Hooper, New York, N.Y.
Joseph Warren Huntress, Jr., Washington, D.C.
Frank Duward Jeans, San Francisco, Calif.
Niels Henrik Jensen, Glenmoore, Pa.
John Montgomery Kyle, Jr., New York, N.Y.
Thomas Densmore Linton, Frankfort, Ky.
George Marley Neff, Danville, Ill.
Mateo Pardo, Tampa, Fla.
Heinrich Press, Charlottenburg, Germany
Irving Munro Salmond, Jackson, Mich.
Roy Gustave Schwamb, Kansas City, Mo.
Soren Peter Shumavon, New York, N.Y.
Edgar Purdy Snow, Providence, R.I.
John Alexander Swanson, St. Paul, Minn.
Martin Gibson Taylor, Jr., Winchester, Ky.
Fernando Torrent, San Juan, Puerto Rico
John William Towers, Arlington, Va.
Adrian William Vaaler, Eugene, Ore.
Leonard Yanko, New York, N.Y.

Applying for Associate Member

Aziz Mahmood Bhatti, Salt Lake City, Utah
Charles John Bogacki, Buffalo, N.Y.
John Lawrence Brockman, Sr., Baltimore, Md.
Leroy Milton Chace, Jr., Kennebunk, Me.
Yung Kang Chin, New York, N.Y.
Reinaldo Cobos Liccia, San Juan, Puerto Rico
Frantz Eli Coe, Denver, Colo.
Elliot Arthur Dewey, Seattle, Wash.
Loren Daniel Ewen, Sacramento, Calif.
Roswell Edgar Finlay, New York, N.Y.
Gilbert Urban Gustafson, Hartford, Conn.
George Shigeyuki Izuta, Honolulu, Hawaii
John Walter Johnson, Jr., Chattanooga, Tenn.
Robert Vernon Longcor, Seattle, Wash.
Compere Loveless, Prairie Village, Kans.
Val Alexander Lyons, Shreveport, La.
Leonard Theodore May, Miami, Fla.
Howard William McCall, Athens, Ohio
Juan Bautista McKay, Panama, S.A.
Fred McLane, Fort Smith, Ark.
Francis Noel, Redding, Calif.
Herbert George Osborne, Santa Ana, Calif.
Patrick Ivor Parker, London, England
Donald Allen Patrick, Mechanicsburg, Pa.
Jason Marion Patrick, Yokosuka, Japan
John Turner Percy, Albany, N.Y.
John Bethel Powers, Texarkana, Tex.
Demetrios Aremistos Polychrone, New York, N.Y.
Thomas William Porter, Jr., Ft. Worth, Tex.
Frank Edwin Richart, Jr., Gainesville, Fla.
Andrew Elvin Tripp, New York, N.Y.
Phillip Joseph Weber, Jr., Los Angeles, Calif.
Duncan Edwin Williams, Madison, Wis.
George Wofford, San Luis Obispo, Calif.
Othar Zaldastani, Boston, Mass.

Applying for Junior Member

Lonnie Ollie Adkins, Jr., St. Paul, Minn.
Melvin Leon Baron, New York, N.Y.
James Welcome Hunt, Topeka, Kans.
Willis Engman Jacobsen, Bonneville, Oreg.
Harry Lee Kay, Jr., Roanoke, Va.
Bogdan James Krause, Chicago, Ill.
Richard Laws, Queensland, Australia
James Francis McGovern, Newburgh, N.Y.
Charles Edward McKinney, Jr., Cleveland, Ohio
Floyd George McLellan, Jr., Los Angeles, Calif.
Julius Michaels, New York, N.Y.
Youssef Moussa Mikhail, Hamadi, Egypt
Hugh Edward Mulholland, Los Angeles, Calif.
Chandoobhai Manibhai Patel, East Lansing, Mich.
Rinaldo Pablo Petrini, Argentina, S.A.
Joshua Tillman Rowe, Baltimore, Md.
Vershall Aaron Roy, Kingsville, Tex.
William Lesley Sheafer, Harrisburg, Pa.
Robert Cameron Snell, Denver, Colo.
Frereen Winfield Hansen, Houston, Tex.

[Applications for Junior Membership from ASCE Student Chapters are not listed.]

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Incineration New York City. . .

This article begins on page 54

Continued from page 59

real estate tax revenue, possibly have an adverse effect on the development of adjoining properties, and hamper possible future adjustments of site areas and locations.

Figure 3 locates the existing and planned incinerators, defines their tributary areas, and indicates their sizes and nature of construction. The term "rehabilitation" is used to mean mechanization with an increase in plant capacity, and "modernization" to mean mechanization without an increase in plant capacity.

Construction Costs Difficult to Evaluate

Capital costs will naturally fluctuate over the span of the program in direct ratio to the building cost index. Such trends are difficult to evaluate. Reasonably accurate broad unit costs were applied, however, based on past experience and recent bids to outline the general cost aspects of this program. It was assumed that new construction would cost from $5,500 to $6,600 per ton per day; modernization, with an attendant increase in plant capacity, from $3,500 to $4,000 per ton per day; and modernization of existing capacities, about $3,500 per ton per day. Actual appropriations will require separate detailed estimates to reflect the type of design chosen and the then current cost structure. Complete fulfilment of this program is thus estimated to cost nearly $70,000,000 (Fig. 4).

Schedule of Construction

A construction span of about 12 years was fixed on the basis of a realistic appraisal of the city's ability to finance the program at the approximate annual rate of $10,000,000. Furthermore, the necessary concurrent site preparation for several planned landfills, for the construction of several new marine transfer stations, and for a huge central automotive repair shop and some 15 garages, was dovetailed in with the incinerator program so as to limit the average total annual capital construction expenditure of the Department of Sanitation to about $15,000,000. Sequence and timing of construction of each individual incinerator was fixed in a manner to assure adequate alternate disposal methods, for the tributary area involved, with minimum disruption to normal Department of Sanitation service and economies. The schedule, Fig. 4, shows the proposed timing and the estimated cost of design and construction of the incinerator program, with a summary of the annual expenditures which are involved.

There is excellent opportunity for progressive and continuing improvement in the design of each plant because of the planned sequence of construction for the 16 plants. It is beyond the scope of this article to discuss the merits of the various available designs. Suffice it to state that the underlying principle is to achieve maximum reduction of volume, health hazards and nuisances, consistent with economy of construction and operation. Coupled with this is the primary need of satisfying public demand for adequate control of the attendant dust, smoke and fly-ash nuisances. This means, in a nutshell, modernization and mechanization to secure optimum incineration.

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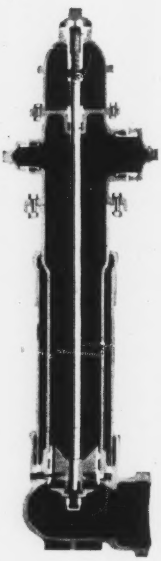

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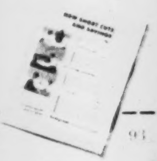

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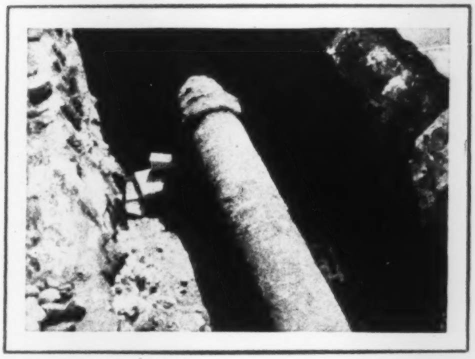

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EQUIPMENT, MATERIALS and METHODS

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Important modifications in the Model P-600 preparizer, which substantially increase its efficiency is announced. An International Harvester UD-24, 180 hp diesel now replaces the previous power plant. This represents an increase of 55 hp over the former engine. In addition, drive-on paddles replace the old time-consuming method of bolting paddles to the rotor shaft. These new type paddles are easily and quickly driven on or off with a sledge, saving considerable in down time for paddle replacement. The preparizer in one operation scarifies and pulverizes old asphalt mats for 100 percent re-use. It handles mats up to 6 in. deep in panels 6 ft wide, and has a capacity up to 1500 sq yds per hr. Aggregate is returned to its original size in one to three passes. The P-600 will reprocess any asphalt material that can be scarified by a motor grader. Wood offers an attachment for the P-600 which converts it into a soil blender. This machine will blend different types of soil with water into a homogeneous mass to depths up to 24 in. loose or 12 in. compacted. **Wood Manufacturing Co., P. O. Box 620, 6900 Tujunga Ave., North Hollywood, Calif.**

Model P-600

Pencil Lead

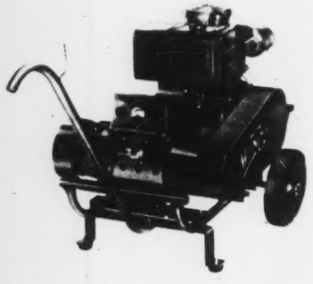
A line of colored pencils that combines greater strength with superb marking qualities, has been perfected. A newly developed plastic binder imparts a unique, pliable strength without a reduction in the marking qualities. Koh-I-Noor Flexicolor No. 1800 colored pencils are made in twenty-four colors, hexagon, with multicolored end tip and pencil polished to match the color of the lead. The colored pencils will stand up under pressure like firm graphite leads yet will deposit colors like soft crayons. Flexicolor pencils sharpen easily, flex under pressure without breaking, and mark with a smooth, clean cut stroke and leave a deep, opaque color deposit. **Koh-I-Noor Pencil Company, Inc., Bloomsbury, N.J.**

Indicator

An improved valve position indicator for filter operating tables, has been announced. This system, using an enclosed bead chain, is entirely mechanical in its operation and requires no electrical, water, or air connections. The monel bead chain is enclosed in a sheath of copper tubing. It is corrosion proof, cannot be damaged or knocked out of adjustment, and eliminates difficulties experienced with the conventional cable and pulley arrangement. Installation costs are reduced through the elimination of idler pulleys which may be difficult to locate properly and costly to install. **Builders-Providence, Inc., 345 Harris Ave., Providence 1, R. I.**

Generator

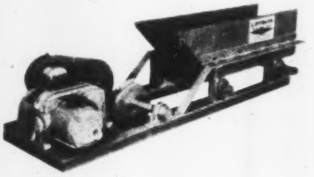
The addition of a new contractor's model of engine-generator set is announced. The Model 4500 is designed for full output at 115 volts, 60 cycles, A.C. It has motor starting capacity of 4500 watts—sufficient to start and run motors up to $1\frac{1}{2}$ hp. The unit has 3000 watts intermittent rating and 2500 watts continuous rating. It easily operates many portable tools such as cut-off saws, electric chain saws, masonry saws, concrete vibrators or lights. Klixon thermostatic cut-out switches with manual reset protect the generator from overload and overheating. The cast iron outlet box located on the top of the generator provides a voltmeter, and one 20 ampere capacity and two 15 ampere capacity twist-lock type outlets wired in parallel. The Model 4500 is available with either the standard tubular cradle base or "Speedy Shift" portable base attachment consisting of a single handle and semi-pneumatic rubber tired wheels so located as to provide practical tip proof mounting, well balanced for easy handling. **Wincharger Corporation, East 7th and Division Sts., Sioux City 2, Iowa.**



Model 4500

Reciprocating Plate Feeder

A ball bearinged Lippmann 20 in. by 5 ft reciprocating plate feeder with babbitt lined eccentric drive for quick simple adjustment and easy replacement accessibility, is announced. Driving it is a 3 hp variable speed electric motor gear reducer with belt drive operating over adjustable pitch sheaves for finer feed control of pit run material for use in pits with excessive varying pit deposits. The dial shown at the rear gives instant speed variation to suit the operator's needs. The finer the pit fed material is the faster the operator sets the feed. Constant flow regardless of material deposit conditions is thus achieved for more efficient profit making operation. A completely enclosed oil lubricated chain drive transmits power to the eccentric shaft from the speed reducer. **Lippmann Engineering Works, 4603 W. Mitchell St., Milwaukee 14, Wis.**



Lippmann Feeder

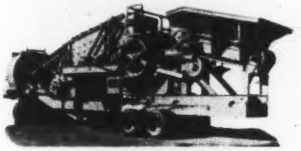
Arc Welder

A 200 ampere, engine-driven d-c arc welder with a 60 percent duty cycle has been announced. Designated as type WD-42AGW, the welder has a current range of 40 to 250 amperes, and can be used with a variety of electrode sizes for repair, maintenance, and construction work. Consisting basically of a G-E type WD42 generator and a Wisconsin air-cooled engine, it is designed to fit crosswise in a standard pick-up truck. Optional equipment includes a trailer equipped with fittings for pressure lubrication. Forced ventilation keeps internal temperature within safety limits when the welder is operated on a 60 percent duty cycle at rated load. In addition, tests indicate that heavy overloads for short periods do not produce harmful results. Maintenance wise, either the generator or engine can be removed easily for overhaul, and replaced by a standby unit. Since the engine is air cooled, coolants or anti-freezes are not required. A vacuum type device saves gasoline by idling the engine when welding is not being done. **General Electric Company, Schenectady 5, N.Y.**

Equipment, Materials & Methods (Continued)

Limerock Plant

A NEW EDITION to the company's 293QH series limerock plants is announced. Designed for 100 percent crushing, the plant features an 18 in. by 30 in. roller bearing jaw crusher, an 18 in. by 31 in. hammer mill, and a 4 ft by 10 ft three deck gyrating screen with ball tray. Special by-passes are built in to give product control making it possible to produce aglime, road rock and chips simultaneously, aglime and chips, aglime and road rock, or all aglime. The primary jaw crusher, apron feeder with by-pass, operator's platform, and structural supports are mounted as a separate unit, on skids, which is bolted to the main frame. The complete primary unit is easily removed to cut weight when traveling. Other features include new, simplified drives with side drive through universal joint connection from truck mounted power. Feed is direct from shovel or by dump trucks from ramp set up. **Universal Engineering Corporation, 625 C Ave. N. W., Cedar Rapids, Iowa.**



Designed for 100 Percent Crushing

Hose for Transferring Concrete

A RUBBER HOSE which can be used to transfer concrete from batch mixer to trucks at a considerable saving in time and cost has been developed. Although the first cost of the hose is higher than the canvas spout usually used by ready mix concrete companies for this purpose, it is more economical in the long run because it lasts at least six months whereas canvas is usually good for an average of one week. Users say the hose remains flexible throughout its life while canvas absorbs the concrete and becomes stiff. The hose is also easier to clean and is free of clogging. A major cost-saving factor is that trucks and other expensive equipment will no longer have to be kept idle at frequent intervals to change the canvas spout. The hose is made in various sizes ranging from 18 in. to 24 in. in diameter and from 18 in. to 36 in. in length. It is made of natural rubber reinforced with two plies of special fabric. In use, one end is attached to the bottom of the batch mixer and the other end hangs free over the hopper of the truck to be loaded. **United States Rubber Company, Rockefeller Center, New York 20, N.Y.**

SAUERMAN FOR FAST MATERIAL HANDLING AT LOWEST COST

Picture shows a Sauerman Slackline Cableway piling rock debris that it removes from tailrace of hydro plant. The sweep of the 800-ft. span cableway takes in the entire section of the tailrace where the debris accumulates. Thus an economical once-a-year operation clears the tailrace of the thousands of yards of rock brought in by the spring floods. One operator, aided by an occasional helper, handles the operation.

More Yardage—Less Labor

Important savings in man-power are effected on many excavating and material handling jobs by the use of Sauerman Scraper and Cableway Machines.

With one man at the controls, and with a relatively small expenditure of power, a Sauerman machine can dig, haul and automatically dump a large hourly yardage of any class of earth or bulk material.

From an economy standpoint, a Sauerman machine has no superior in its field of use. First cost is moderate; upkeep simple; power requirement small.

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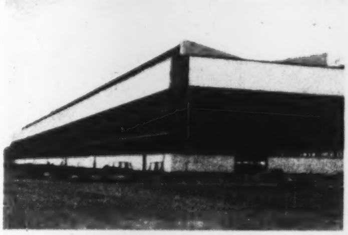

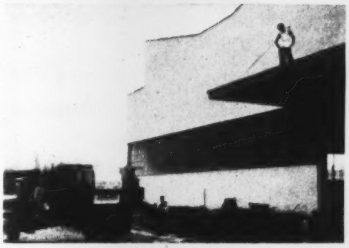

CEMENT GUN COMPANY USES "GUNITE" FOR WALLS OF INDUSTRIAL BUILDINGS

The pictures show the Republic Aviation Corporation building at Farmingdale, N. Y. The walls above the sash and all monitor ends are 2" mesh reinforced "GUNITE" carried on the steel framing. We did this job under plans and specifications prepared by Albert Kahn Associated Architects and Engineers. It is similar to scores of other industrial buildings on which we have built "GUNITE" exterior walls, and in many cases interior partitions.

"GUNITE" provided weatherproof, light-weight, permanent walls for industrial buildings, which fit well into modern industrial architecture. The inside surfaces of the walls are smooth (plywood form surface) and therefore do not collect dust and may be painted as desired.

Many other instances of repair, remodeling and new construction with "GUNITE" are described and pictured in Bulletin B2400. A request, on your letterhead, will bring a free copy by return mail.

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Klemp engineers have exclusively specialized in the fabrication of gratings, such as Hexteel Surface Armor and Floorsteel Flexible Floor Armor for reinforcement of all surfaces where concrete or mastic are applied. In addition, they have developed a bridge decking which is the most up-to-date flooring for modern bridges — prefabricated to exact specifications.

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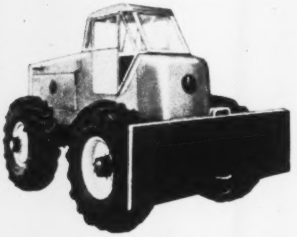
Plant: 6601 SOUTH MELVINA AVENUE, CHICAGO 38, ILLINOIS

Equipment, Materials & Methods (Continued)

Tractor

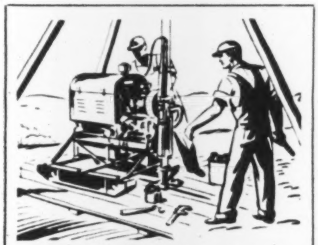
A LARGE AND UNIQUE rubber-tired tractor, having four wheel drive and other important advantages, is announced. Known as the Model TM Payloader tractor, it is available with a 106 hp gasoline engine or a 90 hp diesel engine, weighs 25,000 lbs and develops up to 16,000 lbs and 14,000 lbs drawbar pull, with gasoline and diesel engine respectively. Noteworthy features include: full reversing transmission, providing four gear ratios in both forward and reverse; speeds up to 27 miles per hour; a torque converter drive in addition to a friction clutch; rear wheel steer with hydraulic power booster; 16.00-24 tires all around; operator location for fullest visibility. The Model TM tractor is recommended for heavy-duty drawbar and pushing work, both on and off pavement. It makes a flexible, efficient railroad car switcher and spotter for industrial plants and yards and can pull or push 8 to 10 loaded cars. The torque converter assures precise control for careful spotting and slow, steady application of power for starting heavy loads. Compact design and short wheel base, with sharp turning radius and power booster steer enables this machine to maneuver easily in close quarters. **The Frank G. Hough Co., 18 Seventh Street, Libertyville, Ill.**



Model TM Payloader

Measuring Wheel

THE MODEL 400 Rolatape is a measuring wheel which is exactly 4 ft in circumference and registers distances up to 100,000 ft, then repeats cycle. It accurately measures and records as it is wheeled over course and makes measuring "as easy as walking." Model 400 has been extensively field tested in the contracting field, and is considered ideal for estimating, layout, inventory, invoice checking, pipe line work, electrification surveys, survey work of all kinds. It measures around corners, over contours, with equal facility and accuracy, and does not sway in operation, but tends to stabilize its course and follow a straight line. **Rolatape Inc., Santa Monica, Calif.**



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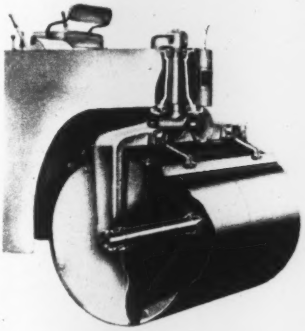
Equipment, Materials & Methods (Continued)

Tandem Rollers

A LINE of 8-12 and 10-14 ton tandem rollers is announced. For field servicing, all vital parts are readily accessible through adequate inspection plates and dust covers. Doors on either side of the engine can be taken off and locked on. The engine is also accessible from the rear, via a shield which encloses the rear of the frame in front of the guide roll. By loosening wing nut screws, the "fan end" of the engine is open for inspection. Roll scrapers are hand-adjustable and all pressure grease fittings are within easy reach. The intermediate drive assembly is protected by an easily removed housing. One of the outstanding features of the Huber tandem is the unit welded frame. Side panels and crossmembers of the frame are cut from deep section, rolled steel, and welded into a deep box. Additional lateral strength is provided by crossmembers of channel which also serve as the engine mountings. The 4-in. drive roll axle adds another strengthening crossmember, since it is bolted rigidly in place between the two side panels of the frame. The kingpin housing is removable, and fits snugly into an especially welded compartment in the rear of the frame. The final drive is machined into the frame in positive center alignment, mounted in rather than on the frame, to assure precision meshing of gears. Power is transmitted through a Twin Disc fluid coupling, and a choice of gasoline or diesel engines is available. The yoke design makes it possible to adjust tapered roller bearings at the kingpin, the yoke swivel pin and the roll axle. Guide rolls on the tandem have internal bracing to eliminate the side thrust on the heads from turning or curbing pressures. A special feature here is a "variable speed" steering valve which an operator can adjust to any desired "feel" for hydraulic steering. The frame design and drive roll mounting allows an unusually close curb clearance. **Huber Manufacturing Company, Marion, Ohio.**



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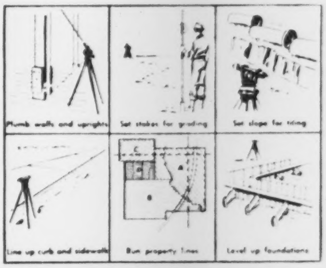

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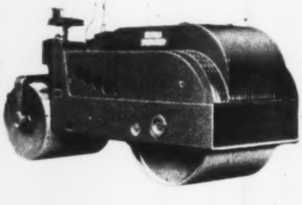
Equipment, Materials & Methods (Continued)

Hoist for Bridge Cranes

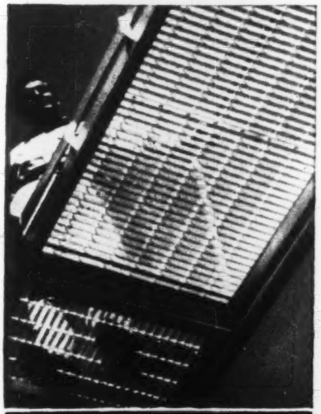
Deck type Cable King electric hoists, designed for top mounting in double girder bridge cranes, are available. The units, available in capacities of from 1 to 15 tons, feature compactness of design, triple reduction, spur geared drive; totally-enclosed, fan cooled motor; rugged heavy steel suspension frame; and pushbutton operated heavy duty contractor. For safety, the hoists are equipped with two brakes: a Weston type friction brake in the gear train, and a solenoid operated contracting drum type motor brake. The control station can be mounted in the crane cab or remotely located. Controls for operation of the trolley and bridge also are available. **The Yale & Towne Manufacturing Company, Philadelphia 15, Pa.**

Tamden Roller

Production is rolling on the C Model 2 axle tandem roller line. Among the most important features are an open grillwork over both sides of the drive roll which allows operators to see the roll edge directly through top of machine, increased ground clearance to 17 in. on 5-9 ton tandems, 20 in. on 8-14 ton tandems, final drive gears armored against possible damage by massive steel plate frame member, and the addition of heavy-duty tapered roller bearings on both roll axles. Other exclusive features include a large hinged top cover that gives complete accessibility to the engine for major overhauls and a 4-speed transmission. This transmission will allow a greater range of road speeds at full engine power. The C Model also has extra-large hinged side covers for easy engine access and cooler operation in hot weather, axles of heavy tie bar construction and removable cap on guide roll yokes for ease of assembly and disassembly. Dual controls and double seat posts permit operation from either side of machine; the radiator is located at guide roll end for clean air intake from top; optional transmission or roll mounted brakes are available. **Buffalo-Springfield Roller Company, Springfield, Ohio.**



The C-Model



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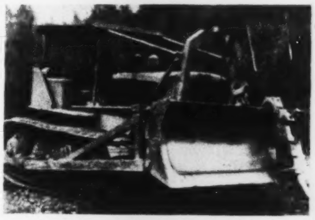
Equipment, Materials & Methods (Continued)

Dozer-Rooter

THE ESCO BUCK FORTE dozer rooter is a heavy duty tooth shank housing which mounts on the mold board of a bulldozer by means of a special clamp used in combination with adapters and saddles which enable it to fit most popular makes of heavy duty dozers. The rooter shank has four adjustments of ripping depths below the dozer's cutting edge and is equipped with ESCO box type replaceable points. Rooters can be attached in pairs or used singly on the dozer. One of its principal advantages is that it enables the operator to rip, root and doze at the same time. It is easily mounted and demounted from the dozer without special equipment and it can be carried from job to job in a pick-up truck or on the dozer. Examples of types of work in which it has excelled are boulder and stump removal, land clearing, ditch work, tearing up old pavements, ripping and handling overburden or cutting seamy rock, roadbuilding pioneering, initial cuts in solid rock, etc. **Electric Steel Foundry Company, 2141 N. W. 25th Ave., Portland 10, Ore.**



Rips, Roots & Dozes Simultaneously

Reversible Pump

A CENTRIFUGAL PUMP which operates with equal efficiency when rotated in either direction has just been announced. Known as the Model Cay, the pump was designed primarily for circulating cooling water in air compressors, diesel and gasoline engines, and other water-cooled machines. Advantages include easy installation in any position on a machine, simplified piping design, and adaptability to any type of drive. The Model Cay has successfully been installed on either side of the same machine without turning the pump around when moving it from one side to the other. It is suitable for heads up to 50 ft and capacities up to 67 gal per min. The pump is fitted with two pre-lubricated ball bearings, and has a mechanical seal that eliminates stuffing box leakage. **Gardner-Denver Company, Quincy, Ill.**

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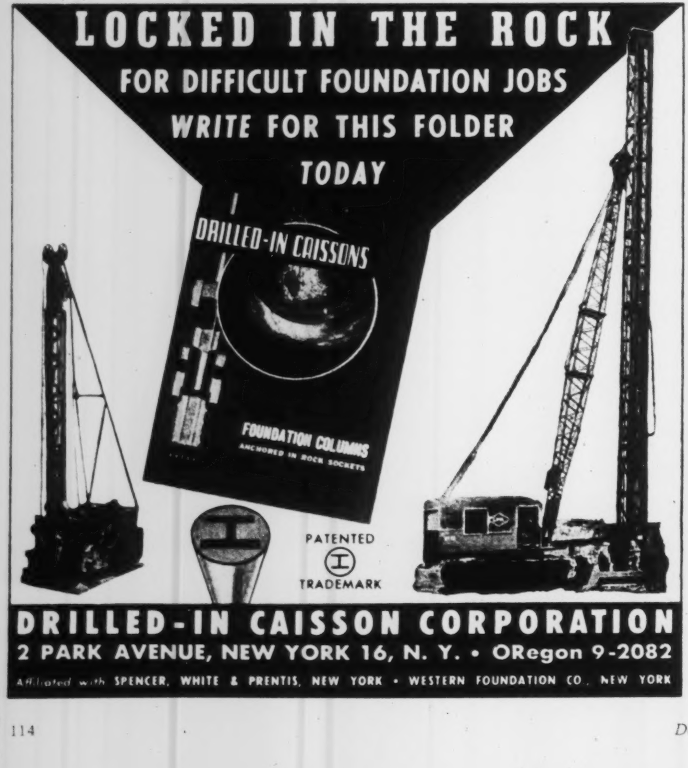

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Equipment, Materials & Methods (Continued)

Gearmotor

A LIFELINE SINGLE-REDUCTION gearmotor (Type B) is available. The gearmotor meets the mounting limitation requirements peculiar to side entry agitators and mixers, and is suitable for light duty coupled service applications such as fans and pumps. It is available in ratings from 1 to 30 hp, 780 to 420 rpm, AGMA classes I and II. By using reduction gears, gearmotors have the advantage of being able to deliver power at speeds comparable to slow speed motors while utilizing smaller and more efficient high speed motors. **Westinghouse Electric Corporation, P. O. Box 2099, Pittsburgh 30, Pa.**

Type B

Lift Trucks

TWO COMPLETELY new fork lift truck models have just been released to industry. They are an 8,000 lb capacity truck and a 6,000 lb capacity model. Both are gasoline engine powered and mounted on pneumatic tires. Designed as an ideal "outside" truck, the ZA 80 is the first heavy duty 8,000 lb industrial truck of its kind that can be operated efficiently indoors as well as out. Special attention was given to operator comfort, ease of daily servicing and safety. Other outstanding features are shorter over-all length, longer wheelbase and better weight distribution than usually found in a truck of this size. The XA 60 model is a 6,000 lb capacity version of the ZA 80 incorporating all the rugged heavy duty features of the larger truck, but with shorter wheelbase, width and over-all length. The smallest and heaviest 6,000 lb capacity truck ever designed, the XA 60 is distinguished by its compactness, maneuverability and versatility on the job. Among the many new mechanical features of both trucks are a long life clutch that can be completely removed or installed in less than an hour, and large heavy duty disc type industrial brakes that eliminate many service and maintenance problems. In addition, both use powerful industrial engines designed especially for the grueling work lift trucks are subjected to. **Hyster Company, 2902 N. E. Clackamas St., Portland 8, Ore.**

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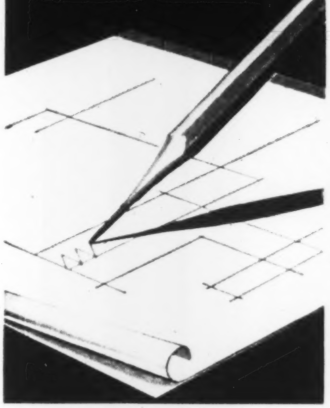

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ASPHALTIC PAVING MAINTENANCE METHODS. A wealth of information on the use of Bitumuls emulsified asphalt in maintenance work is contained in a 24-page, two-color brochure designed for use by contractors, city, county, state and Federal paving engineers and authorities. A total of 86 photographs with concise, easy-to-read captions and other descriptive material are used to illustrate the economy and versatility of Bitumuls emulsified asphalt in repairing every type of paved surface. **American Bitumuls & Asphalt Company, 200 Bush St., San Francisco 4, Calif.**

WATER CONTROL GATES. Pekrul Catalog No. 49 is descriptive of the gates for the following applications: sewage disposal, power plants, flood control, reservoirs, cooling towers, dams, drainage, water works, irrigation, etc. General applications of Pekrul gates, installation pictures, a guide for use in ordering gates, and general information and specifications are included. **Fekrul Gate Division, Morse Bros. Machinery Company, 2900 Brighton Blvd., Denver 1, Colo.**

BITUMINOUS PAVER. A bulletin on the Model BP-6 bituminous paver, designed for laying all types of bituminous material, has been issued. Features include: almost instant width adjustability from 9 ft to 12½ ft, oscillating compaction and finishing controlled with tiltable screens, handles the most difficult materials, automatic, positive matching to level of adjacent course, curb, gutter or other structure. The 12-page booklet is fully illustrated, explains operating details and includes complete specifications. **Pioneer Engineering Works, Inc., 1515 Central Ave., Subsidiary of Poor and Co., Minneapolis 13, Minn.**

WEATHER GUIDE. A handy pocket size "Guide to the Weather" contains sixteen four-color photos of different types of skies, with simple explanations of the weather they foretell. It is claimed that with the aid of this booklet, you will be able to forecast the weather with remarkable accuracy. **The Galion Iron Works & Mfg. Co., Galion, Ohio.**

SKID SHOVELS. A large two-color folder just published will be of interest to operators, contractors, engineers—anyone engaged in earthmoving. The folder announced three models of the Drott skid shovel for International tractors: 1¼ yd for TD-9, 2 yd for TD-14A and 3 yd for TD-18A. Many revolutionary features, never before seen on tractor equipment, are fully described and illustrated. Complete specifications are included. **Drott Manufacturing Corp., 3841 W. Wisconsin Ave., Milwaukee 8, Wis.**

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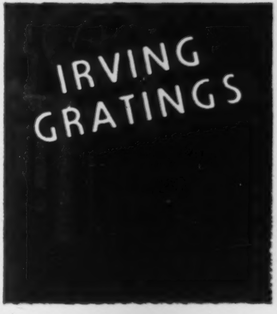

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WOOD

Literature Available (Continued)

Wood Preserver. A booklet entitled, "Why Creosote Protects Wood Today Every Bit as Well as Fifty Years Ago," will be of particular interest. As indicated by its title, it is based on facts that give complete answers to any questions about the quality of today's Creosote. Detailed charts, photographs, and other informative material are included. **Koppers Company, Inc., Tar Products Div., Pittsburgh 19, Pa.**

Wrought Iron Identification. Five tests for the positive identification of wrought iron pipe are described in a brochure. The identification booklet also tells why recognition of piping material is important and explains how to protect against the use of substitutes. **A. M. Byers Company, Clark Bldg., Pittsburgh, Pa.**

Trench Loading Tables. A revised edition of the popular reference booklet of "Trench Loading Tables" has been published. Based on the standard and widely used Marston formula, the tables were developed to help in computing trench work and to reduce the possibility of error in calculating backfill loads on clay pipe. Complete reference tables show the estimated loading according to pipe size, trench depth and width, and type of backfill. **A. E. Williams, Sales Mgr., Vitrified Products Div., The Robinson Clay Product Company, 65 West State St., Akron 9, Ohio**

Plumbing Data Booklet. A useful data booklet for the construction industries has been published to simplify the job of layout and installation of cast iron drainage plumbing. Entitled, "Guide for Federal Specifications WWP 401", it combines for the first time in a single publication Federal specifications for service weight and extra heavy cast iron soil pipe and fittings. The booklet cover information necessary in laying out soil, waste and vent systems in accordance with government standards. **Cast Iron Soil Pipe Institute, 1627 K St., N. W., Washington 6, D. C.**

Wire Cloth, Filter Cloth, Fabricated Products. A 126-page catalog which is in reality a textbook of the wire cloth, filter cloth and fabricated products industry, has been published. It is a work of the greatest value to all those who have anything to do with any or all of the above materials and products manufactured from them. It contains specifications, characteristics and uses of wire cloth and filter cloth and includes a complete picture of the scope of the fabrication service offered by the company. The catalog is profusely illustrated and contains many pages of very valuable engineering data. **Multi-Metal Wire Cloth Co., Inc., 1350 Garrison Ave., New York 59, N. Y.**

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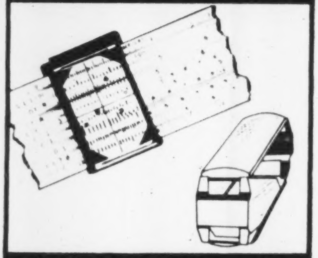

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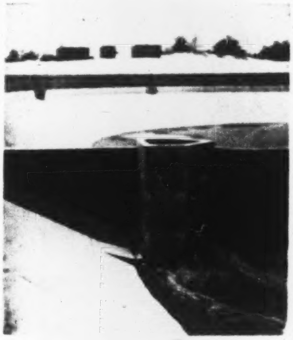

Fig. B-144-A

One of Two 48" Type M Gates installed in Ft. Stanton Park Reservoir, Washington, D. C., to maintain direction of flow. See Feb. 22, 1944, issue Engineering News Record for story about this project.

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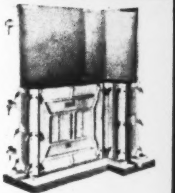

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Literature Available (Continued)

TIRE GUIDEBOOK. A 12 page industrial tire guidebook has been released. The booklet shows the complete B. F. Goodrich industrial tire line, the service in which each tire should be used and contains many useful maintenance tips on the care of industrial tires. The guidebook also points out the advantages of the company's tire & wheel analysis plan, as nationally advertised. **Advertising Department, B. F. Goodrich Company, 500 S. Main St., Akron, Ohio.**

PIPE. A 24 page manual on the large diameter Multi Plate pipe is announced. Manual MP 1652 explains the engineering and design features of Multi Plate, tells where and how to use it and illustrates a wide variety of installations. There is a section on technical data with generous use of charts, tables and graphs, and a handy check list of the company's other products. **Armco Steel Corporation, Middletown, Ohio.**

WATER SOFTENERS. Troubles caused by the utilization of hard water and the multiple economies effected by curing them are thoroughly discussed in a comprehensive 16-page bulletin. The bulletin lists several industries in which steam and water are of importance. It explains the three basic types of ion exchange equipment and shows how these units can be profitably utilized. **The Permutit Company, 330 West 42nd St., New York 36, N.Y.**

WIRE ROPE USE AND CARE BOOKLET. As a completely up-to-date guide to improved wire rope service, a pocket-size booklet on the "Use and Care of Wire Rope" is now available. The booklet contains 72 pages of practical information on proper methods of handling, reeving, breaking in, splicing, cutting, lubricating, and specifying wire rope. Included are over 50 illustrations and 32 diagrams and charts to demonstrate and explain suggestions and recommendations for proper wire rope use and care. **Dept C-51, A. Leschen & Sons Rope Co., 5909 Kennerly Ave., St. Louis 12, Mo.**

HIGH PRESSURE PUMPS. Design and plant engineers with high pressure pumping problems will find in Bulletin 43 295, much useful data: dimensions, capacities, cutaway drawings on pumps from 600 to 5,000 psi or 1.1 to 16.5 gpm. Direct drive and back-geared models are described for such uses as high pressure testing or back washing of pipes, valves, vessels, boilers; for high pressure boiler feeding; for hydraulic presses on baling, bending, straightening, shaping, forming, laminating, die casting or pressure molding operations. Special triplex cylinder construction with an exclusive packing feature is shown in cross-section view. Bulletin 43 295 contains six pages of facts and data. **American-Marsh Pumps, Inc., Battle Creek, Mich.**

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Literature Available (Continued)

Centrifugal Pump. A bulletin covering general purpose centrifugal pumps of the cradle mounted type, has just been released. The bulletin covers five basic cradle groups and seventeen corresponding pump types, their capacities, horsepower ratings and uses. There are also two pages covering pump dimensions and a table of performance under 60 cycle use. In addition, two pages describing special purpose units and design modifications are included. Request Form 7223. **Ingersoll-Rand Company, Department C.P., 11 Broadway, New York 4, N.Y.**

Arc Welders. An 8-page folder illustrating and describing the complete line of Hobart gasoline engine driven arc welders is offered. Complete electrical and mechanical specifications are given for the arc welders and combination model of arc welder and power unit. **Hobart Brothers Company, Troy, Ohio**

Motor Grader. An attractive catalog on the Model 118 extra heavy duty motor grader has been issued. It is illustrated with many action photos and detailed views of construction and operation features. The construction and advantages of Galion's advanced hydraulic control system, all gear four wheel tandem drive, six speed constant mesh transmission, and combination manual and hydraulic booster steering are presented in detail. **The Galion Iron Works & Mfg. Co., Galion, Ohio.**

Maintenance Booklet. "Maintenance Tips for Unpaved Roads" is a 36-page booklet prepared especially to aid engineers and patrolmen in the maintenance of unpaved roads. It is well illustrated and contains helpful procedures for application of calcium chloride and maintenance of roads in all seasons. Special features of the booklet include helpful tables, and a list of twenty pertinent questions on maintenance procedures with answers based on practical field experience. **Calcium Chloride Institute, 909 Ring Bldg., Washington 6, D. C.**

Power Steer Booster. A brochure on the Air-O-Matic power steer booster describing the utilization of compressed air to bring lower cost, safer, easier steering to owners and operators of commercial and heavy duty vehicles, is just off the press. The 4-page, two color folder clearly emphasizes the advantages of power steering under all operating conditions. It contains an installation diagram, specification tables, pictures of actual on the job installations as well as other information to aid buyers of power steering equipment. **Air-O-Matic Power Steer Corp., 24 Noble Court, N. W., Cleveland 13, Ohio**

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Summarized in Earlier Issues

145. **Torsion of I-Type and H-Type Beams,** by John E. Goldberg.

146. **Electrical Analogies and Electrical Computers: Surge and Water Hammer Problems,** by Henry M. Paynter.

147. **The Delaware Memorial Bridge: Design Problems,** by Charles H. Clarahan, Jr., and Elmer K. Timby.

D-84. Discussion of Paper, **Longitudinal Mixing Measured by Radioactive Tracers,** by Harold A. Thomas, Jr., and Ralph S. Archibald.

148. **Bank Stabilization by Revetments and Dikes,** by Raymond H. Haas and Harvill E. Weller.

149. **Industrial Waste Treatment in Iowa,** by Paul Bolton.

150. **East St. Louis Veterans Memorial Bridge,** by A. L. R. Sanders.

151. **Topographic Mapping in Kentucky,** by Phil M. Miles.

152. **Methods for Making Highway Soil Surveys,** by K. B. Woods.

153. **Characteristics of Fixed-Dispersion Cone Valves,** by Rex A. Elder and Gale B. Dougherty.

Third Notice

154. **A Navigation Channel to Victoria, Tex.,** by Albert B. Davis, Jr.

155. **Field Study of a Sheet-Pile Bulkhead,** by C. Martin Duke.

156. **Rice Irrigation in Louisiana,** by E. E. Shutts.

D-78. Discussion of Paper, **River Channel Roughness,** by Hans A. Einstein and Nicholas L. Barbarossa.

D-109. Discussion of Paper, **Final Foundation Treatment at Hoover Dam,** by A. Warren Simonds.

Second Notice

157. **Radial Impact on an Elastically Supported Ring,** by Edward Wenk, Jr.

158. **Flexure of Double Cantilever Beams,** by F. E. Wolosewick.

D-108. Discussion of Paper, **Control of Embankment Material by Laboratory Testing,** by E. C. Walker and W. G. Holtz.

D-113. Discussion of Paper, **Wave Forces on Breakwaters,** by Robert Y. Hudson.

D-115. Discussion of Paper, **Lake Michigan Erosion Studies,** by John R. Hardin and William H. Booth, Jr.

First Notice

159. **Development of a Flood-Control Plan for Houston, Tex.,** by Ellsworth I. Davis. This paper examines the problems arising from delay in construction of flood-control plans in one of the most rapidly growing communities in the United States, and outlines steps in revising the flood-control plan. The procedure in developing a project design flood is presented and a comparison made of plans for diversion of floodwaters and for rectification of stream channels to carry the floodwaters. The problems of the disposal of large quantities of excavated material in developed municipal areas are discussed. The author writes of the advantage of lining flood discharge channels under certain conditions. (Available January 1.)

160. **Studies of the Effects of Temperature Variations,** by Bertil Lofquist. The magnitude of the ice pressure remains as one of the major uncertainties in the design of hydraulic structures. Opinions often differ considerably. However, relatively little has been done to solve this problem, possibly because of the complexity of the task. The author has measured directly the pressures in an artificial ice sheet in a freezing chamber. The results are somewhat contradictory to earlier investigations. The ice pressure does not seem to increase with the thickness of the ice sheet, but a maximum value is found for a thickness of approximately 20 in. The author has arrived at a maximum pressure of from 20,000 lb per lin ft to 27,000 lb per lin ft. These figures are based mainly on calculations of the buckling load in the ice sheet. (Available January 1.)

161. **Some Investigations in Canada,** by A. D. Hogg. The thick ice and possible high ice pressures in existing and projected reservoirs in Ontario and other provinces necessitate the determination of design values for maximum ice pressures. This paper describes equipment and methods used in this work, and indicates the extent to which such experimentation has been carried on at several Canadian dams. (Available January 1.)

162. **Experimental Investigations by the Bureau of Reclamation,** by G. E. Monfore. A description of investigations of the pressures produced by thermal expansion of ice sheets is presented for discussion. The construction of equipment and the test procedures are explained. The program included numerous

INSTRUCTIONS

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measurements at five reservoirs, and the effects of shore line characteristics and solar radiation have been considered. Laboratory investigations which verified the field measurements included studies of the effects of initial ice temperature and rate of temperature rise. (Available January 1.)

163. **Design Methods for Airfield Pavements: Progress Report of the Committee on Correlation of Runway Design Procedures of the Air Transport Division.** The design of airfield pavements has received increased attention since World War II. The methods used in the United States and Canada were studied and compared by the committee. Qualitative comparisons are found practicable on the basis of the relationships between the California Bearing Ratio used by the Corps of Engineers and the subgrade strength indices used by the Canadian Department of Transport, the Civil Aeronautics Administration, and the United States Navy. The Westergaard procedure for the design of concrete pavements is summarized and compared with the CAA method. (Available January 1.)

D-69. Discussion of Paper, **Valuation and Depreciation Related to Income Tax,** by Maurice R. Scharff. This paper, published in May 1951, is concerned with the importance of income tax considerations in comparing the economic feasibility of engineering projects and the effect of these taxes on valuation and depreciation of existing public utility plants. Discussers are George J. Sotter, Eugene L. Grant, and Maurice R. Scharff. (Available January 1.)

D-77. Discussion of Paper, **Buckling Stresses for Flat Plates and Sections,** by Elbridge Z. Stowell, George J. Heimerl, Charles Libove, and Eugene E. Lundquist. This paper, published in July 1951, describes studies of the buckling of flat unstiffened plates using the stress-strain curve to calculate buckling stresses in the plastic range, and correlating buckling strength and maximum strength. Discussers are P. P. Bijlaard and Elbridge Z. Stowell, George J. Heimerl, Charles Libove, and Eugene E. Lundquist. (Available January 1.)

D-89. Discussion of Paper, **Deflections in Gridworks and Slabs,** by Walter W. Ewell, Shigeo Okubo, and Joel I. Abrams. The original paper, published in September 1951, deals with the determination of elastic deformations in plates and slabs by means of an analogous gridwork of beams intersecting at right angles. Discussers are Jack R. Benjamin, Alexander C. Scordelis, Paul J. Brennan, Serge Leliavsky Bey, W. Watters Pagon, Phil M. Ferguson, Robert V. Whitman, and Walter W. Ewell, Shigeo Okubo, and Joel I. Abrams. (Available January 1.)

D-90. Discussion of Paper, **Consumptive Use of Water by Forest and Range Vegetation,** by L. R. Rich. This paper, published in October 1951, presents data for determining the type of vegetation that interferes least with water yield and still controls erosion and sediment. Discussers are M. J. Vouhotsky and L. R. Rich.

D-91. Discussion of Paper, **Consumptive Use of Water,** by Harry F. Blaney. The original paper, published in October 1951, deals with the determination of consumptive use of water in valley areas on the basis of climatology, irrigation, and other data, and presents the results of experimental measurements of evapo-transpiration. Discussers are George H. Hargreaves, William W. Donnan, and Harry F. Blaney. (Available January 1.)

D-93. Discussion of Paper, **Aircraft Design as Related to Airport Standards,** by Milton W. Arnold. This paper, published in October 1951, is concerned with the correlation between the design of airports and aircraft necessary if the cost of providing adequate airports and the over-all cost of providing all-weather operation are to be kept to a minimum. Discussion by John H. Geisse. (Available January 1.)

D-97. Discussion of Paper, **Consumptive Use in the Rio Grande Basin,** by Robert L. Lowry. The original paper, published in November 1951, deals with the control of consumptive use of water in order to make more water available for irrigation. Discussers are Isom H. Hale and George A. Whetstone, H. R. McDonald, and Robert L. Lowry. (Available January 1.)

D-98. Discussion of Paper, **Consumptive Use of Water on Irrigated Land,** by Wayne D. Criddle. This paper, published in November 1951, indicates a range in the amount of water consumed by varying types of vegetation under different climatic conditions in the United States. Discussers are Clyde E. Houston and Wayne D. Criddle. (Available January 1.)

D-99. Discussion of Paper, **Consumptive Use in Municipal and Industrial Areas,** by George B. Gleason. The original paper, published in November 1951, describes a survey to determine the consumptive use of water in municipal and industrial areas. Discussers are Robert H. Born and Meyer Kramsky. (Available January 1.)

D-101. Discussion of Paper, **Application of Highway Capacity Research,** by J. P. Buckley. The original paper, published in November 1951, describes the development and use of comprehensive capacity charts for the cases of two-lane rural roads, two-way city streets, and one-way city streets. Discussers are Donald S. Berry, Joseph Barnett, O. K. Normann, and J. P. Buckley. (Available January 1.)

D-102. Discussion of Paper, **Utilization of Ground Water in California,** by T. Russel Simpson. The original paper, published in November 1951, traces the development of the utilization of ground water for irrigation in California and gives detailed descriptions of the use of ground water in the major hydrographic areas of the state. Discussers are Dean C. Muckel and T. Russel Simpson. (Available January 1.)

D-103. Discussion of Paper, **Pile Foundations for Large Towers on Permafrost,** by L. A. Nees. This paper, published in November 1951, describes a series of tests leading to the determination of design factors for pile foundations on permafrost soil. Discussers are Harry Carlson and L. A. Nees. (Available January 1.)

D-105. Discussion of Paper, **Principles of Highway Capacity Research,** by O. K. Normann. The original paper, published in November 1951, summarizes the results of investigations of overtaking and passing practices, motor vehicle performance, driver behavior, and traffic flow at intersections. Discussers are F. L. Fieldhammer and O. K. Normann. (Available January 1.)

D-112. Discussion of Paper, **Diversions from Alluvial Streams,** by C. P. Lindner. This paper, published in January 1952, explains the effects of diversions and their withdrawal of sediment from alluvial streams, describing characteristics of the flood hydrograph and of the stage-discharge relation, developing factors affecting the quantity of bed-load diversion, and presenting a conception of the balanced stream. Discussers are T. Blench, Serge Leliavsky Bey, A. R. Thomas, D. C. Bondurant, and C. P. Lindner. (Available January 1.)

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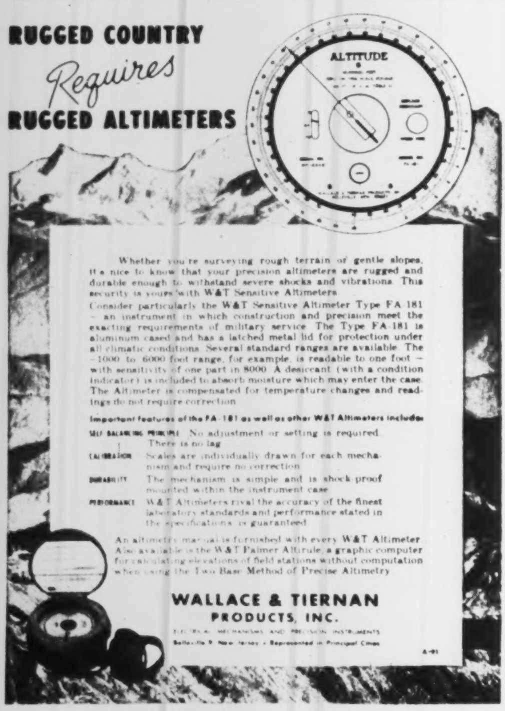

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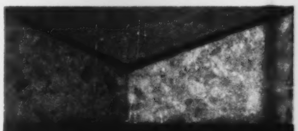

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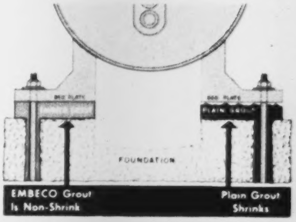

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